AQA GCSE Physics | 8463

SPECIFICATION POINT 4.6.2.1

Types of electromagnetic waves

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**73**
Available paper years	**2004–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.6.2.1 Types of electromagnetic waves

Answer 01 · Mark scheme June 2004 | 3451H | Original Q2 | Legacy

The full source mark scheme begins on page 56. Follow original question 2 in that document.

Answer 02 · Mark scheme June 2004 | 3451H | Original Q12 | Legacy

The full source mark scheme begins on page 56. Follow original question 12 in that document.

Answer 03 · Mark scheme June 2004 | 3462H3 | Original Q2 | Legacy

The full source mark scheme begins on page 77. Follow original question 2 in that document.

Answer 04 · Mark scheme June 2004 | 3462H3 | Original Q10 | Legacy

The full source mark scheme begins on page 77. Follow original question 10 in that document.

Answer 05 · Mark scheme June 2005 | 3451 | Original Q10 | Legacy

The full source mark scheme begins on page 94. Follow original question 10 in that document.

4.6.2.1 Types of electromagnetic waves

Answer 06 · Mark scheme June 2005 | 3462 | Original Q8 | Legacy

The full source mark scheme begins on page 112. Follow original question 8 in that document.

Answer 07 · Mark scheme November 2006 | PHY1B | Original Q2 | Legacy

Two	**A**	gamma rays	**1**
	B	infra red rays	**3**
	C	radio waves	**4**
	D	ultraviolet waves	**2**

Answer 08 · Mark scheme November 2006 | PHY1B | Original Q7 | Legacy

Seven	**3**	**2**	**4**	**4**

Answer 09 · Mark scheme January 2007 | PHY1H | Original Q3 | Legacy

No matching mark scheme was available in the supplied archive for this question.

Answer 10 · Mark scheme January 2007 | PHY1H | Original Q5 | Legacy

No matching mark scheme was available in the supplied archive for this question.

Answer 11 · Mark scheme March 2007 | PHY1B | Original Q2 | Legacy

Two	**A**	electron	**1**
	B	nucleus	**4**
	C	neutron	**3**
	D	proton	**2**

4.6.2.1 Types of electromagnetic waves

Answer 12 · Mark scheme March 2007 | PHY1B | Original Q4 | Legacy

Four	**A**	away from	**2**
	B	beyond	**4**
	C	furthest	**3**
	D	towards	**1**

Answer 13 · Mark scheme June 2007 | PHY1B | Original Q5 | Legacy

Five	**2**	**4**	**4**	**4**

Answer 14 · Mark scheme June 2007 | PHY1B | Original Q6 | Legacy

Six	**4**	**1**	**3**	**1**

Answer 15 · Mark scheme June 2007 | PHY1B | Original Q7 | Legacy

Seven	**3**	**1**	**1**	**4**

Answer 16 · Mark scheme June 2007 | PHY1B | Original Q9 | Legacy

Nine	**3**	**1**	**3**	**1**

4.6.2.1 Types of electromagnetic waves

Question 4 continued

(ii)	check validity / reliability of the evidence **or** change the theory to match the new evidence	accept comparison of new and old evidence	1
total			8

PHY1H Question 5

	answers	extra information	mark
(a)(i)	a signal that has only two states / only discrete states	accept can only be on or off accept made up of 1 and 0 only accept high and low accept diagram with all amplitudes equal	1
(ii)	400 000 000 **or** correct equivalent	allow **1** mark for correct transformation **and** substitution (of 75) answer 4 000 000 gains **1** mark only	2

Continued on next page

4.6.2.1 Types of electromagnetic waves

Answer 18 · Mark scheme

November 2007 | PHY1B | Original Q2 | Legacy

Two	**A**	infra red radiation	**1**		
	B	ultraviolet radiation	**3**		
	C	visible light	**2**		
	D	X-rays	**4**		
	A		**B**	**C**	**D**

Answer 19 · Mark scheme

November 2007 | PHY1B | Original Q5 | Legacy

Five	**4**	**2**	**1**	**1**

4.6.2.1 Types of electromagnetic waves

Answer 20 · Mark scheme

January 2008 | PHY1H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
(a) E	C or 0.18 mm		1
(b) E	0.6 m	allow **1** mark for correct transformation and substitution allow **1** mark for changing frequency to Hz answer 600 gains **1** mark	2
(c) E	creates an alternating current with the same frequency as the radio wave **or** it gets hotter	accept 'ac' for alternating current accept alternating voltage accept signal for radio wave	1 1
(d) E	X-rays cannot penetrate the atmosphere **or** X-rays are absorbed *(*by the atmosphere*)*	accept atmosphere stops X-rays do **not** accept atmosphere in the way before reaching Earth ignore explanations	1
total			6

4.6.2.1 Types of electromagnetic waves

Answer 20 · Mark scheme January 2008 | PHY1H | Original Q5 | Legacy

PHY1H

Answer 21 · Mark scheme March 2008 | PHY1BP | Original Q2 | Legacy

Two	**A**	gamma rays	**2**		
	B	radio waves	**3**		
	C	ultraviolet waves	**4**		
	D	visible light	**1**		
	A		**B**	**C**	**D**

Answer 22 · Mark scheme March 2008 | PHY1BP | Original Q6 | Legacy

Six	**3**	**2**	**4**	**2**

Answer 23 · Mark scheme March 2008 | PHY1BP | Original Q7 | Legacy

Seven	**4**	**4**	**2**	**2**

Answer 24 · Mark scheme March 2008 | PHY1BP | Original Q9 | Legacy

Nine	**4**	**4**	**4**	**3**

4.6.2.1 Types of electromagnetic waves

Answer 25 · Mark scheme June 2008 | PHY1H | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
(a)	Hubble telescope is above the (Earth's) atmosphere	accept no / little atmosphere	1
	atmosphere distorts <u>image</u> **or** atmosphere scatters <u>light</u>	do **not** accept light / waves distorted accept picture for image accept no clouds (to block light) accept no light pollution answers in terms of closer to stars neutral	1
(b)	to check it works (correctly) **or** less risk of a fault (once in space)		1
	too far away (for astronauts) to travel to / to fix	accept its difficult to send astronauts to repair / maintain it dangerous / expensive is insufficient	1
(c)	to test the design works	accept idea of fault finding or modifying the design	1
(d)	(visible) light can pass through the atmosphere		1
	X-rays are absorbed by the atmosphere **or** X-rays cannot pass through the atmosphere		1
total			7

4.6.2.1 Types of electromagnetic waves

Answer 25 · Mark scheme June 2008 | PHY1H | Original Q3 | Legacy

PHY1H

Answer 26 · Mark scheme November 2008 | PHY1BP | Original Q5 | Legacy

Five	**3**	**2**	**1**	**2**

Answer 27 · Mark scheme November 2008 | PHY1BP | Original Q9 | Legacy

Nine	**3**	**4**	**2**	**3**

4.6.2.1 Types of electromagnetic waves

Answer 28 · Mark scheme

January 2009 | PHY1H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)(i)	radio(waves)		1
5(a)(ii)	energy	correct answer only	1
5(b)(i)	0.0125 (m)	allow **1** mark for correct transformation and substitution	2
5(b)(ii)	make it hot(ter)	do **not** accept cook it accept (air) particles inside ball will move faster accept water in the ball gets hotter	1
5(b)(iii)	wavelength decreases frequency increases	ignore reference to speed	1 1
5(c)(i)	both variables are continuous	accept the data is continuous	1

Question 5 continues on the next page

4.6.2.1 Types of electromagnetic waves

PHY1H

Question 5 continued

question	answers	extra information	Mark
5(c)(ii)	digital data can be (easily) processed by a computer **or** digital analogue data cannot (easily) be processed by a computer	both parts needed do **not** accept answers in terms of interference / quality / clearer signals	1
5(c)(iii)	<u>digital</u> a signal that has only two states / discrete values <u>analogue</u> a signal that varies continuously	accept can only be on or off accept made up of 1 and 0 only allow both marks for two correct diagrams correctly labelled digital and analogue allow **1** mark for two correct diagrams but not labelled	1 1
Total			**11**

4.6.2.1 Types of electromagnetic waves

Answer 29 · Mark scheme March 2009 | PHY1BP | Original Q4 | Legacy

Four	**2**	**3**	**2**	**3**

Answer 30 · Mark scheme March 2009 | PHY1BP | Original Q5 | Legacy

Five	**4**	**2**	**3**	**3**

Answer 31 · Mark scheme March 2009 | PHY1BP | Original Q9 | Legacy

Nine	**2**	**3**	**4**	**3**

Answer 32 · Mark scheme June 2009 | PHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	microwaves	**3**
	B	X-rays	**1**
	C	visible light	**2**
	D	radio waves	**4**

Answer 33 · Mark scheme June 2009 | PHY1BP | Original Q6 | Legacy

Six	**3**	**4**	**2**	**2**

Answer 34 · Mark scheme June 2009 | PHY1BP | Original Q7 | Legacy

Seven	**4**	**1**	**3**	**4**

Answer 35 · Mark scheme June 2009 | PHY1BP | Original Q8 | Legacy

Eight	**4**	**1**	**1**	**2**

4.6.2.1 Types of electromagnetic waves

Answer 36 · Mark scheme June 2009 | PHY1H | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)(i)	HESS	accept gamma	1
1(a)(ii)	infra red	accept IR accept answers written in table do **not** accept heat	1
1(b)	clearer / more detailed / sharper / less distorted image any **one** from: • no light pollution • light is not scattered by the atmosphere	do **not** accept image is bigger accept no clouds to prevent observations accept light is scattered by the atmosphere (implies William Herschel) accept light does (not have to) pass through the atmosphere accept air for atmosphere do **not** accept answers in terms of distance	1 1

Question 1 continues on the next page . . .

4.6.2.1 Types of electromagnetic waves

PHY1H

Question 1 continued . . .

question	answers	extra information	mark
1(c)	any **two** from: • <u>microwaves absorbed</u> by water (molecules) • signal strength greater (in dry environment) • more sensitive (in dry environment) • detect weaker signals (in dry environment) • more detailed / clearer image (in dry environment)	accept more microwaves reach telescope accept harder to detect signals in a humid environment accept image contains more information do **not** accept better image	2
1(d)	a fourth / extra galaxy / star	accept a planet / another object / source	1
Total			**7**

4.6.2.1 Types of electromagnetic waves

Answer 36 · Mark scheme June 2009 | PHY1H | Original Q1 | Legacy

PHY1H

Answer 37 · Mark scheme November 2009 | PHY1BP | Original Q7 | Legacy

Seven	**4**	**1**	**3**	**3**

Answer 38 · Mark scheme November 2009 | PHY1BP | Original Q9 | Legacy

Nine	**3**	**2**	**4**	**3**

4.6.2.1 Types of electromagnetic waves

Answer 39 · Mark scheme

January 2010 | PHY1H | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	microwaves		1
3(a)(ii)	can pass through the ionosphere	accept travels in a straight line accept atmosphere for ionosphere do **not** accept air for ionosphere	1
3(b)	any **two** from: • analogue is continuously varying • digital has only discrete values • digital is less prone to interference (than analogue) • digital can be processed more easily (than analogue) by a computer	 do **not** accept analogue has many values accept digital is on or off accept digital is 1 or 0 accept digital is binary accept digital is easier to restore	2
3(c)	higher the frequency, further the wave travels (into the atmosphere before reflection)		1
3(d)	15 000	allow **1** mark for correct transformation and substitution ie $\frac{300\,000\,000}{20}$ an answer of 15 000 000 only gains **1** mark allow both marks for an answer of 15 MHz (unit must be changed) an answer of 15 gains no credit	2
Total			**7**

4.6.2.1 Types of electromagnetic waves

Answer 39 · Mark scheme January 2010 | PHY1H | Original Q3 | Legacy

PHY1H

Answer 40 · Mark scheme March 2010 | PHY1BP | Original Q9 | Legacy

Nine	**1**	**4**	**4**	**3**

Answer 41 · Mark scheme June 2010 | PHY1BP | Original Q3 | Legacy

Three	3	3	4	2

Answer 42 · Mark scheme June 2010 | PHY1BP | Original Q6 | Legacy

Six	2	2	2	2

4.6.2.1 Types of electromagnetic waves

Answer 43 · Mark scheme

June 2010 | PHY1H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	any **two** from: • travel at the same speed (through a vacuum) • can travel through a vacuum / space • transfer energy • can be reflected • can be refracted • can be diffracted • can be absorbed • can be transmitted • transverse	 accept travel at the speed of light accept air for vacuum do **not** accept air for vacuum accept any other property common to electromagnetic waves accept travel at the same speed through a vacuum for both marks do **not** accept both radiated from the Sun	2
4(a)(ii)	infra red radio(waves)	**both** required for the mark accept IR for infra red	1

Question 4 continues on the next page . . .

4.6.2.1 Types of electromagnetic waves

PHY1H

Question 4 continued . . .

question	answers	extra information	mark
4(b)	2400000000	correct transformation and substitution gains **1** mark ie $\frac{300000000}{0.125}$ **or** $\frac{300000000}{12.5}$ an answer of 24000000 gains **1** mark **either** 2400000 kHz **or** 2400 MHz scores **3** marks but the symbol only scores the 3rd mark if it is correct in every detail	2
	hertz	accept Hz do **not** accept hz	1
4(c)(i)	presented (scientific) evidence / data	do an experiment / investigation is insufficient	1
4(c)(ii)	to find out if there is a hazard (or not)	accept to find out if it is safe accept not enough evidence to make a decision not enough evidence is insufficient	1
Total			**8**

4.6.2.1 Types of electromagnetic waves

Answer 43 · Mark scheme June 2010 | PHY1H | Original Q4 | Legacy

PHY1H

Answer 44 · Mark scheme November 2010 | PHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	decreased	**3**
	B	increased	**2**
	C	shifted	**1**
	D	not changed	**4**

Answer 45 · Mark scheme November 2010 | PHY1BP | Original Q5 | Legacy

Five	**3**	**3**	**1**	**4**

Answer 46 · Mark scheme November 2010 | PHY1BP | Original Q6 | Legacy

Six	**3**	**2**	**1**	**2**

4.6.2.1 Types of electromagnetic waves

Answer 47 · Mark scheme

January 2011 | PHY1H | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)	higher frequency **or** shorter wavelength **or** greater energy	general properties / uses are neutral do **not** accept different frequency / wavelength / energy	1
1(b)	the same (speed)	accept they travel at the speed of light	1
1(c)	pass through / transmitted by the plastic / casing <u>reflected</u> by the metal / plates	 do **not** accept bounce / deflected etc for reflected if neither marking point scores an answer reflected (back to boat / from the device) scores **1** mark	1 1
1(d)(i)	waves are not <u>reflected</u> from the walls **or** only waves (reflected) from the device are detected	accept microwaves / radar for waves do **not** accept bounce / deflected etc for reflected accept to stop reflected waves affecting results	1

Question 1 continues on the next page . . .

PHY1H

Question 1 continued . . .

question	answers	extra information	mark
1(d)(ii)	different types (of device) can be compared	fair test is insufficient accept idea that only one variable is then changed	1
1(d)(iii)	so (measurements / results / scientists) are not biased towards one type / manufacturer of device/s	accept to avoid bias accept so they are not biased	1
1(e)(i)	any **two** from: • (for any angle) **A** values < **B** values • **A** values increase with (increasing) angle • **B** values decrease with (increasing) angle • **A** values do not vary as much (as **B** values)	if temperature is mentioned rather than angle a maximum of **1** mark can be scored **or** converse eg **B** values are higher / better / stronger accept weakest at 0° strongest at 15° values go up is insufficient accept strongest at 0° weakest at 15° values go down is insufficient	2
1(e)(ii)	**D** values are always over 2(.0)	mark is for the reason reason cannot score if **D** is not chosen	1
Total			**10**

4.6.2.1 Types of electromagnetic waves

Answer 47 · Mark scheme January 2011 | PHY1H | Original Q1 | Legacy

PHY1H

Answer 48 · Mark scheme March 2011 | PHY1AP | Original Q8 | Legacy

Eight	**2**	**4**	**2**	**4**

Answer 49 · Mark scheme March 2011 | PHY1BP | Original Q4 | Legacy

Four	**A**	gamma rays	**1**
	B	infra red rays	**3**
	C	radio waves	**4**
	D	ultraviolet rays	**2**

Answer 50 · Mark scheme March 2011 | PHY1BP | Original Q9 | Legacy

Nine	**4**	**1**	**2**	**2**

4.6.2.1 Types of electromagnetic waves

Answer 50 · Mark scheme

March 2011 | PHY1BP | Original Q9 | Legacy

GCSE

SCIENCE A (4461) / PHYSICS (4451)

Objective Test Answer Key

PHY1BP (Radiation and the Universe)

March 2011

Higher Tier

Question	Key		
One	**A**	a belief that science cannot disprove	**1**
	B	a conclusion based on observations of red-shift	**3**
	C	a theory supported by scientific evidence but not direct observations	**4**
	D	a theory that science has disproved	**2**
Two	**A**	Isotope **A**	**4**
	B	Isotope **B**	**1**
	C	Isotope **C**	**3**
	D	Isotope **D**	**2**

	A	**B**	**C**	**D**
Three	**1**	**3**	**2**	**1**
Four	**4**	**1**	**2**	**2**
Five	**4**	**3**	**4**	**3**
Six	**2**	**3**	**2**	**4**
Seven	**1**	**2**	**3**	**4**
Eight	**3**	**2**	**4**	**2**
Nine	**2**	**3**	**4**	**3**

4.6.2.1 Types of electromagnetic waves

Answer 51 · Mark scheme June 2011 | PHY1BP | Original Q4 | Legacy

Four	**2**	**3**	**4**	**1**

Answer 52 · Mark scheme June 2011 | PHY1BP | Original Q5 | Legacy

Five	**1**	**4**	**2**	**3**

Answer 53 · Mark scheme June 2011 | PHY1BP | Original Q8 | Legacy

Eight	**3**	**4**	**2**	**3**

4.6.2.1 Types of electromagnetic waves

Answer 54 · Mark scheme

June 2011 | PHY1H | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	microwave(s)		1
3(a)(ii)	has discrete values only **or** has only 2 states	accept can only be on or off accept made up of 1 and 0 only accept has high and low (values only) accept a diagram with discrete levels do **not** accept can be switched on and off	1
3(a)(iii)	any **one** from: • less (prone to) interference • can be (easily) processed by computers • better quality (signal) • digital signals can be restored • information / data can be compressed	it refers to signal accept no interference accept interference causes less / no permanent damage accept noise / distortion for interference accept can be processed without an analogue to digital converter better on its own is insufficient accept can send more information in same time do **not** accept faster	1

Question 3 continues on the next page

4.6.2.1 Types of electromagnetic waves

PHY1H

Question 3 continued

question	answers	extra information	mark
3(b)	2 000 000 000	allow **1** mark for correct transformation and substitution ie $\frac{300\,000\,000}{0.15}$ or $\frac{300\,000\,000}{15}$	2
	hertz	accept Hz do **not** accept hz accept kHz / MHz / GHz **but** for full credit the answer and unit must be consistent eg answers 2 GHz; 2000 MHz; 2 000 000 kHz gain **3** marks	1
3(c)(i)	infra red (radiation)	accept IR ignore reference to light	1
3(c)(ii)	travel a shorter distance	do **not** accept faster	1
Total			**8**

4.6.2.1 Types of electromagnetic waves

Answer 54 · Mark scheme June 2011 | PHY1H | Original Q3 | Legacy

PHY1H

Answer 55 · Mark scheme November 2011 | PHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	gamma rays	**1**
	B	infra red rays	**3**
	C	radio waves	**2**
	D	ultraviolet rays	**4**

Answer 56 · Mark scheme November 2011 | PHY1BP | Original Q6 | Legacy

Six	**4**	**2**	**3**	**2**

Answer 57 · Mark scheme November 2011 | PHY1BP | Original Q9 | Legacy

Nine	**4**	**4**	**3**	**3**

The AQA UMS Conversion Calculator can be found at the following web address:

http://www.aqa.org.uk/umsconversion

4.6.2.1 Types of electromagnetic waves

Answer 58 · Mark scheme

June 2012 | PH1HP | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)	any **two** from: • travel (at same speed) through a vacuum / space • transverse • transfer energy • can be reflected • can be refracted • can be diffracted • can be absorbed • travel in straight lines	do **not** accept air for vacuum	2
5(b)	can pass through the ionosphere	accept atmosphere for ionosphere do **not** accept air for ionosphere accept travel in straight lines accept not refracted / reflected / absorbed by the ionosphere	1
5(c)	diffraction (of waves around hills) wavelength needs to be similar size to the obstacle / gap radio has a long enough wavelength **or** TV doesn't have a long enough wavelength	an answer TV (waves / signals) have short wavelengths so do not diffract (around the hill) scores **2** marks	1 1 1

Question 5 continues on the next page

4.6.2.1 Types of electromagnetic waves

PH1HP

Question 5 continued

question	answers	extra information	mark
5(d)		$v = f \times \lambda$	
	1.2×10^6 / 1200 000	allow **1** mark for correct substitution ie $3.0 \times 10^8 = f \times 2.5 \times 10^2$	2
	hertz / Hz	do **not** accept hz **or** HZ accept kHz **or** MHz answers 1.2 MHz **or** 1200 kHz gain all **3** marks for full credit the unit and numerical value must be consistent	1
Total			**9**

4.6.2.1 Types of electromagnetic waves

Answer 58 · Mark scheme

June 2012 | PH1HP | Original Q5 | Legacy

PH1HP

4.6.2.1 Types of electromagnetic waves

Answer 59 · Mark scheme

June 2012 | PH1HP | Original Q8 | Legacy

Question 8

question	answers	extra information	mark
8(a)	any **three** from: • red-shift shows galaxies are moving away (from each other / the Earth) • more distant galaxies show bigger red-shift **or** more distant galaxies show a greater increase in wavelength • (in all directions) more distant galaxies are moving away faster • suggests single point of origin (of the universe)	accept correct reference to frequency in place of wavelength accept (suggests) universe is expanding	3
8(b)(i)	(radiation produced shortly after) 'Big Bang'	accept beginning of time / beginning of the universe for 'Big Bang'	1
8(b)(ii)	any **one** from: • can only be explained by 'Big Bang' • existence predicted by 'Big Bang' • provides (further) evidence for 'Big Bang'	ignore proves 'Big Bang' (theory) ignore reference to red-shift	1

Question 8 continues on the next page

4.6.2.1 Types of electromagnetic waves

Answer 59 · Mark scheme

June 2012 | PH1HP | Original Q8 | Legacy

PH1HP

Question 8 continued

question	answers	extra information	mark
8(b)(iii)	increase universe continues to accelerate outwards **or** greater red-shift	accept becomes radio waves accept as universe continues to expand	1 1
Total			**7**

UMS Conversion Calculator www.aqa.org.uk/umsconversion

4.6.2.1 Types of electromagnetic waves

Answer 60 · Mark scheme

January 2013 | PH1HP | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)(i)	gamma	accept correct symbol	1
5(a)(ii)	any **one** from: • (ultraviolet has a) higher frequency • (ultraviolet has a) greater energy • (ultraviolet has a) shorter wavelength	ultraviolet cannot be seen is insufficient ignore ultraviolet causes cancer etc	1
5(b)	1.2×10^7 / 12 000 000 hertz / Hz / kHz / MHz	allow **1** mark for correct substitution, ie $3 \times 10^8 = f \times 25$ do **not** accept hz **or** HZ answers 12 000 kHz **or** 12 MHz gain **3** marks for full credit the numerical answer and unit must be consistent	2 1
5(c)(i)	away (from each other)	accept away (from the Earth) accept receding	1
5(c)(ii)	distance (from the Earth) speed galaxy is moving	accept how far away (it is)	1 1
5(c)(iii)	(Universe is) expanding		1
Total			**9**

4.6.2.1 Types of electromagnetic waves

Answer 60 · Mark scheme

January 2013 | PH1HP | Original Q5 | Legacy

PH1HP

4.6.2.1 Types of electromagnetic waves

Answer 61 · Mark scheme

June 2013 | PH1HP | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	perpendicular	accept correct description	1
3(a)(ii)	light off – no / slow rotation		1
	light on – fast(er) rotation	accept starts rotating ignore references to energy transfers	1
3(b)	one ray drawn from wrist watch and reflected by mirror	accept solid or dashed lines	1
	two rays drawn from wrist watch and reflected by mirror with i = r for both rays	judge angles by eye	1
	one ray traced back behind mirror	accept solid or dashed lines	1
	image in correct position	judged by eye accept image marked where two reflected rays traced back cross behind the mirror	1
3(c)	cannot be formed on a screen **or** rays of light seem to come from it but do not pass through it	accept image formed behind the mirror	1
Total			**8**

4.6.2.1 Types of electromagnetic waves

Answer 61 · Mark scheme

June 2013 | PH1HP | Original Q3 | Legacy

PH1HP

4.6.2.1 Types of electromagnetic waves

Answer 62 · Mark scheme

June 2013 | PH1HP | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)	10^{-15} metres to 10^{4} metres		1
7(b)(i)	any **one** from: • (TV / video / DVD) remote controls • (short range) data transmission • optical fibre (signals)	mobile phones is insufficient accept specific example, eg linking computer peripherals do **not** accept Bluetooth	1
7(b)(ii)	0.17	an answer 17 cm gains **3** marks an answer given to more than 2 significant figures that rounds to 0.17 gains **2** marks allow **1** mark for correct substitution, ie $3 \times 10^{8} = 1.8 \times 10^{9} \times \lambda$	3
7(c)	(maybe) other factors involved	accept a named 'sensible' factor, eg higher stress / sedentary lifestyle / overweight / smoking more / diet / hot office / age not testing enough people is insufficient unreliable data is insufficient	1
Total			**6**

4.6.2.1 Types of electromagnetic waves

Answer 62 · Mark scheme

June 2013 | PH1HP | Original Q7 | Legacy

PH1HP

4.6.2.1 Types of electromagnetic waves

Answer 63 · Mark scheme

June 2013 | PH1HP | Original Q8 | Legacy

Question 8

question	answers	extra information	mark
8(a)(i)	origin of the Universe	accept (why) the Universe is expanding do **not** accept origin of the Earth	1
8(a)(ii)	provided more evidence to support the 'Big Bang' theory		1
8(b)(i)	red-shift	accept Doppler (shift)	1
8(b)(ii)	(at the point in time shown the observed spectrum from) star A (shows it) is moving away from the Earth light from star B shows a decrease in wavelength so star B is moving towards Earth	accept star A is moving away star A shows red-shift is insufficient accept light from star B shows blue-shift accept light from star B shows an increase in frequency	1 1 1
Total			**6**

UMS Conversion Calculator: www.aqa.org.uk/umsconversion

4.6.2.1 Types of electromagnetic waves

Answer 64 · Mark scheme

June 2014 | PH1HP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO spec ref
3(a)	infrared / IR	correct answer only	1	AO1 1.1.1a
3(b)	any **two** from: • increase the power / watts • decrease the speed • put biscuits through again	 allow increase the temperature of the oven or make the oven hotter allow leave the biscuits in for longer increase radiation is insufficient ignore changes to the design of the oven	2	AO2 1.3.1c
3(c)	(inside) surface is a (good) reflector or poor absorber (of IR) (and) outside surface is poor emitter (of IR) (so) increases the energy reaching the biscuits	ignore bounce for reflect surface is a (good) reflector of light does not score surface is a (good) reflector of light and infrared / heat does score allow reduces energy loss or makes oven more efficient do **not** accept no energy losses keeps oven hotter is insufficient	1 1 1	AO1 1.1.1c, d
Total			**6**	

4.6.2.1 Types of electromagnetic waves

Answer 65 · Mark scheme June 2015 | PH1HP | Original Q4 | Legacy

The full source mark scheme begins on page 126. Follow original question 4 in that document.

Answer 66 · Mark scheme June 2015 | PH1HP | Original Q5 | Legacy

The full source mark scheme begins on page 126. Follow original question 5 in that document.

Answer 67 · Mark scheme June 2016 | PH1HP | Original Q4 | Legacy

The full source mark scheme begins on page 142. Follow original question 4 in that document.

4.6.2.1 Types of electromagnetic waves

Answer 68 · Mark scheme

June 2017 | PH1HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)	transverse		1	AO1 1.5.1c
1(b)	4.6×10^{14} (Hz)	an answer that rounds to 4.6×10^{14} scores 2 marks allow **1** mark for correct substitution ie $3.0 \times 10^{8} = f \times 6.5 \times 10^{-7}$	3	AO2 1.5.1j
1(c)	10^{-15} to 10^{4}		1	AO1 1.5.1e
Total			**5**	

4.6.2.1 Types of electromagnetic waves

Answer 68 · Mark scheme

June 2017 | PH1HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.

4.6.2.1 Types of electromagnetic waves

Answer 69 · Mark scheme

June 2019 | 8463/2H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7.1	The frequency increases and the wave speed in air stays the same		1	AO1/1 4.6.2.1 iso
7.2	pass through soft tissue (but) absorbed by bone	allow penetrate for pass through allow skin/muscle/etc… for soft tissue pass through tissue is insufficient allow do not pass through bone do not accept reflected by bone	1 1	AO1/1 4.6.2.4
7.3	accept a sensible practical suggestion eg • complete the investigation standing up • use (slightly) cooler water • do not touch the hot cube	do not accept use cold water pour water in carefully is insufficient ignore wear safety goggles or gloves	1	AO2/2 4.6.2.2 WS2.4
7.4	distance between each side (of the cube) and the (infrared) detector	allow distance between cube and detector	1	AO1/2 4.6.2.2 WS2.2
7.5	measurements (for each surface) have not been repeated (to show that they cluster closely)	do not accept any answer for measurement should be repeated for any reason other than to show they cluster eg to show accuracy / average / anomalies would be wrong	1	AO3/3b 4.6.2.2 WS3.7
7.6	(the student) could not conclude that black surfaces always emit more (infrared) than a white surface (as) the reading for the matt white and shiny black would both be 66 (°C)	a (matt) white surface (appears to) emit(s) the same amount (of infrared) as a (shiny) black surface the conclusion is wrong is insufficient allow (as) the reading for the matt white and shiny black would be the same	1 1	AO3/1a/2b 4.6.2.2 WS2.2
7.7	0.0	allow 0 allow zero	1	AO1/1 4.6.3.1

4.6.2.1 Types of electromagnetic waves

Answer 69 · Mark scheme

June 2019 | 8463/2H | Original Q7

7.8	at night, more radiation is emitted from the Earth than absorbed from space cloud reflects radiation (towards the Earth) at A, (there is no cloud cover so) a larger proportion of radiation will be emitted into space	 allow solar radiation for radiation 	1 1 1	AO1/1 4.6.3.2
Total			**12**	

4.6.2.1 Types of electromagnetic waves

Answer 70 · Mark scheme

November 2021 | 8463/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	any **one** from: • (sun) tan • energy efficient lamps	allow • (invisible) security coding • detecting forged bank notes • kill microbes • attract insects • sterilise (surgical) equipment • cause the body to produce vitamin D • increasing the growth rate of plants • water purification	1	AO1 4.6.2.4
05.2	3×10^{-7} m		1	AO1 4.6.2.1
05.3	$3.0 \times 10^{8} = \text{frequency} \times 3 \times 10^{-7}$ $\text{frequency} = \frac{3.0 \times 10^{8}}{3 \times 10^{-7}}$ frequency = 1×10^{15} (Hz)	allow ecf from question **05.2**	1 1 1	AO2 4.6.1.2
05.4	**Wave** / **Name** Wave E → Infrared Wave F → Visible light Wave G → X-rays all three lines correct for **1** mark		1	AO3 4.6.2.1

4.6.2.1 Types of electromagnetic waves

Answer 70 · Mark scheme

05.5	in a transverse wave, the oscillations / vibrations are perpendicular to the direction of energy transfer in a longitudinal wave, the oscillations / vibrations are parallel to the direction of energy transfer	allow direction of wave travel for direction of energy transfer	1 1	AO1 4.6.1.1

Total			**8**

4.6.2.1 Types of electromagnetic waves

Answer 71 · Mark scheme

June 2024 | 8463/1H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	nuclei neutrons gamma (rays)	this order only	1 1 1	AO1 4.4.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	energy = power × time **or** $E = P \times t$		1	AO1 4.2.4.2 4.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	P = 500 000 000 (W)		1	AO2 4.2.4.2 4.1.1.4
	E = 500 000 000 × 3600	allow a correct substitution of an incorrectly / not converted value of P	1	
	E = 1 800 000 000 000 (J) **or** $E = 1.8 \times 10^{12}$ (J)	allow an answer consistent with an incorrectly / not converted value of P	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	any **one** from: • bury the radioactive waste • put the radioactive waste in cooling ponds • transport the radioactive waste in secure vessels • store the radioactive waste in metal containers • cover the radioactive waste in concrete	allow store it for (at least) one half-life ignore references to high / medium / low level waste ignore label the waste as hazardous	1	AO3 4.4.2.4

4.6.2.1 Types of electromagnetic waves

Answer 71 · Mark scheme

June 2024 | 8463/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	number of days = $\frac{92}{100} \times 365$		1	AO2 4.1.3
	number of days = 335.8	allow answers of 335 and 336 days allow an answer of 29.2 (days) for 1 mark	1	

Total Question 2	10

4.6.2.1 Types of electromagnetic waves

Answer 72 · Mark scheme

June 2024 | 8463/2H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	planets dwarf planets moons **or** natural satellites	 allow asteroids / meteors / meteoroids / meteorites allow comets	1 1 1	AO1 4.8.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	Betelgeuse		1	AO3 4.8.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	1.1×10^{17} m		1	AO2 4.8.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	both show red-shift so both are moving away from us **or** the wavelength of the (absorption) lines has increased so both are moving away from us A shows a greater red-shift (than B) so A is travelling faster (than B)		1 1 1	AO3 4.8.2

4.6.2.1 Types of electromagnetic waves

Answer 72 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	$s = 3.6 \times 10^{17}$ (m)		1	AO2 4.5.6.1.2
	$3.6 \times 10^{17} = 3.0 \times 10^{8} \times t$	allow a correct substitution of an incorrectly / not converted value for *s*	1	
	$\frac{3.6 \times 10^{17}}{3.0 \times 10^{8}} = t$	allow a correct re-arrangement using an incorrectly / not converted value for *s*	1	
	$t = 1.2 \times 10^{9}$ (s) **or** $t = 1\ 200\ 000\ 000$ (s)	allow a correct calculation using an incorrectly / not converted value for *s*	1	

Question	Answers	Mark	AO / Spec. Ref.
03.6	**Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	3–4	AO1 4.8.1.2
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1–2	
	No relevant content	0	
	Indicative content • fusion occurs at high temperatures • fusion produces new elements • hydrogen nuclei fuse to form helium nuclei • hydrogen (in the core) begins to run out • helium nuclei fuse to make heavier elements • up to iron • some massive stars become supernovae • creating elements heavier than iron		

Total Question 3	16

4.6.2.1 Types of electromagnetic waves

Answer 73 · Mark scheme

June 2025 | 8463/2H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	convex	allow converging	1	AO1 4.6.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	(the parallel) rays converging rays meeting/crossing at the principal focus		1 1	AO2 4.6.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	0.60 μm = 0.6 × 10^{-6} m $3.0 \times 10^8 = f \times 0.6 \times 10^{-6}$ $f = \frac{3.0 \times 10^8}{0.6 \times 10^{-6}}$ $f = 5.0 \times 10^{14}$ (Hz)	allow 0.60 μm = 0.000 000 6 m all subsequent marks may be awarded if wavelength is incorrectly / not converted	1 1 1 1	AO2 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	wavelength		1	AO1 4.8.2

4.6.2.1 Types of electromagnetic waves

Answer 73 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	distant galaxies are moving away from our galaxy		1	AO1 4.8.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	the distance to this galaxy is greater than any previously observed galaxies		1	AO3 4.8.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	a gravitational / centripetal / resultant force acts on the satellite		1	AO1 4.8.1.3
	(so) the satellite accelerates (towards the centre of the orbit)	do **not** accept acceleration causes a change in speed	1	
	(so) the direction changes (which changes the velocity)		1	

Total Question 4	**13**

GCSE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Physics Specification B
3451/F

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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4.6.2.1 Types of electromagnetic waves

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4.6.2.1 Types of electromagnetic waves

GCSE PHYSICS

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

- the marks available for each part of the question;
- the total marks available for the question;
- the typical answer or answers which are expected;
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:
where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Where *Quality of written communication* appears in the mark scheme, one mark is to be awarded for either of the following points:

- Using correct scientific terms
- Correct sequencing or linking of ideas or points

The mark scheme will specify which of the points is to be awarded in a particular question. A QoWC mark can be awarded for a scientific answer, even if it is not accurate. It cannot be awarded for a nonsensical or non-scientific answer.
On the script, the QoWC tick should be identified by a 'q' written next to it.

3.2 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

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4.6.2.1 Types of electromagnetic waves

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

If a candidate writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.
However:

- if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column;
- if the answer is correct, but an incorrect relationship is written in the working, then no marks can be awarded (see 3.5.2).

3.5.2 Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

3.6 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

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4.6.2.1 Types of electromagnetic waves

3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.8 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.9 Brackets

(…..) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.10 Interpretation of marginal points

There will be times when the answer is almost, but not quite, correct. Some examiners would award a mark while others would not. In any one script, an attempt should be made to balance these nearly correct answers by giving the mark on some occasions but not on others. If this is not done, the marking would end up being too lenient or too harsh.

3.11 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

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4.6.2.1 Types of electromagnetic waves

GCSE Physics
Foundation Tier 3451/F

3451F Q1

question	answers	extra information	mark
(a)	comet	correct order only	1
	elliptical		1
	Milky Way		1
	Universe		1
(b)(i)	D A C B	allow **2** marks for two letters in the correct place allow **1** mark for one letter in the correct place	3
(ii)	A		1
total			8

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4.6.2.1 Types of electromagnetic waves

3451F Q2

question	answers	extra information	mark
(a)	95		1
(b)	alpha	accept correct symbol	1
(c)	any **two** from: • radiation is outside the body • radiation will not reach (living) cells • radiation absorbed by the air	 accept detector is on ceiling or high up the wall accept radiation cannot pass through the body / skin accept cannot pass through the plastic casing do **not** accept because it is alpha radiation – unless qualified do **not** accept does not give off harmful substance do **not** accept cannot pass through building materials etc.	2
(d)	less (than)		1
total			5

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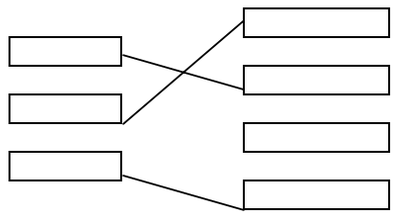
4.6.2.1 Types of electromagnetic waves

3451F Q3

question	answers	extra information	mark
(a)	generator	accept dynamo accept alternator	1
(b)(i)	1400	ignore units	1
(ii)	0.3 or 30%	any incorrect unit penalise **1** mark allow **1** mark for the correct use of 600 **or** 0.3% **or** 30	2
(c)	**1** mark for each correct link 	if more than 3 lines are drawn, mark only 3 lines starting with those that are incorrect	3
(d)(i)	110	no tolerance	1
(ii)	12	no tolerance	1
(iii)	wind speed may be too low to operate the generator	accept wind may not always blow accept power depends on wind speed accept does not generate if wind speed is too high accept does not generate if wind speed is above 12 (m/s) accept does not generate if wind speed is below 1.6 (m/s) accept it is unreliable do **not** accept answers referring to cost only	1
total			10

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4.6.2.1 Types of electromagnetic waves

3451F Q4

question	answers	extra information	mark
(a)	B E A D	allow **1** mark for each letter in the correct place, to a maximum of **3** marks	3
(b)	(a spark) may cause the (petrol vapour) to explode / ignite	accept petrol for (petrol vapour) accept catch fire for explode	1
	connect tanker to earth with a (conducting) wire / chain **or** earth the tanker	accept ground for earth	1
(c)	**Quality of written communication**	for a logical sequence	1
	any **two** from:		2
	• when current greater than fuse rating / value	accept when current too great for appliance do **not** accept 'if there is too much current' do **not** accept voltage or electricity	
	• fuse (becomes hot and) melts / burns out	accept fuse blows / breaks	
	• circuit is broken	accept circuit switched off this cannot score credit on its own	
total			8

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4.6.2.1 Types of electromagnetic waves

3451F Q5

question	answers	extra information	mark
(a)(i)	crust		1
(ii)	inner core is solid outer core is liquid	do **not** accept just rock inner core is denser / hotter than outer core gets **2** marks accept one is solid and one is liquid for **1** mark accept they are different densities for **1** mark wrong way round = **0** marks	1 1
(b)	seismograph		1
(c)	difficult to measure (slow) movement (1) of plates (1) dependent mark **or** difficult to measure friction / forces (1) between plates (1) dependent mark		1 1
(d)	geothermal		1
(e)(i)	5000		1
(ii)	2500		1
total			9

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4.6.2.1 Types of electromagnetic waves

3451F Q6

	answers	extra information	mark
(a)	converging image object image object shorter		1 1 1 1 1 1
(b)(i)	(Earth's) gravity	accept centripetal accept minor misspellings, however, do **not** credit any response which could be 'centrifugal'	1
(ii)	to(wards) (the centre of the) Earth	allow inwards do **not** accept downwards	1
(c)(i)	**either** friction (force) **or** centripetal force between the tyres / wheels and (the surface of) the road	 allow grip allow on the tyres / wheels **or** towards the centre of the bend / arc / circle	 1 1
(ii)	mass **or** speed **or** momentum radius / diameter	allow weight allow velocity do **not** credit 'curvature' or 'circumference'	1 1
(d)	centripetal	accept minor misspellings (see above)	1
total			13

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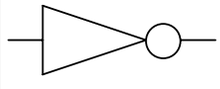
4.6.2.1 Types of electromagnetic waves

3451F Q7

	answers	extra information	mark
(a)(i)	two switches in series **and** circuit complete	ignore small imperfections	1
(ii)	two switches in parallel **and** circuit complete	ignore small imperfections	1
(iii)	one switch in parallel with the cell / lamp (but **not** both)	ignore small imperfections	1
(iv)	(i) AND (ii) OR (iii) NOT	accept 'and' accept 'or' accept 'not'	1 1 1
(b)(i)	when it is light the sensor sends on / high / 1 signal to the gate off / low / 0 sent to the lamp **or** when it is dark the sensor sends off / low / 0 signal to the gate (1) on / high / 1 sent to the lamp (1)		1 1
(ii)	any suitable application	e.g. to switch a security light on (and off) e.g. to switch a light on when it is dark do **not** credit just '… to switch a light on / off'	1
(c)(i)		accept shading-in of either or both parts end connections are not required accept any orientation	1
(ii)	1 0 **or** 0 1 0 1 1 0	all correct	1
(iii)	truth (table)		1
total			12

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4.6.2.1 Types of electromagnetic waves

3451F Q8

question	answers	extra information	mark
(a)	60		1
(b)	$5\frac{1}{2}$ hours	must include unit	1
(c)	30		1
(d)	30 minutes or $\frac{1}{2}$ hour	must include unit	1
(e)	D **and** E least steep part of the graph	accept finish for E accept correct numbers from axes with units accept covers smallest distance in a set time accept only moves 5 km in $1\frac{1}{2}$ hours (accept anything between 5 and 6) ignore horse is tired	1 1
total			6

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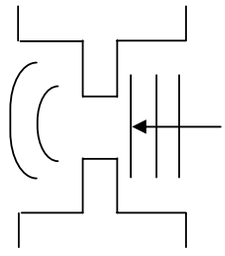
4.6.2.1 Types of electromagnetic waves

3451F Q9

question	answers	extra information	mark
(a)(i)	any **one** from: • (doctors) to see inside a patients body **or** endoscope • telephone cables • optical fibre / fibre optic lamps **or** (artificial) Christmas trees • data transfer **or** internet connection	 accept keyhole surgery do **not** accept flex **or** wires for cable accept decorative / ornamental lighting accept any feasible practical suggestion for taking light to a difficult to access place do **not** accept lighting unqualified do **not** accept lamp unqualified do **not** accept communications unless clarified	1
(ii)	(incident) ray angle greater than critical angle total internal reflection occurs	either order accept (incident) ray greater than 42° accept TIR do **not** accept just description of TIR	1 1
(b)(i)	waves shown diffracting in the correct direction 	ignore wavelength	1
(ii)	diffraction	accept diffract / diffracted	1
total			5

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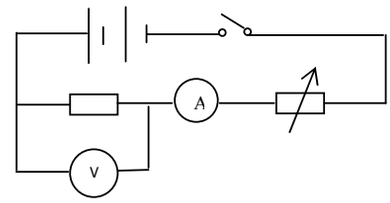
4.6.2.1 Types of electromagnetic waves

3451F Q10

question	answers	extra information	mark
(a)	all symbols correct	 accept push switch symbol switch may be open or closed any lines through symbols = **0** marks	1
	correct circuit drawn voltmeter must be across resistor only	polarity of cells not relevant provided they are joined correctly two cells are required in the diagram ignore the order of the components allow small gaps in circuit omission of any component = **0** marks	1
(b)(i)	potential difference = current × resistance	accept voltage or p.d. for potential difference accept $V = I \times R$ accept  provided subsequent use correct do **not** accept C for current	1
(ii)	2	 allow **1** mark for correct substitution wrong working loses both marks	2
(iii)	straight line drawn <u>through the origin</u> straight line passes through $I = 0.4, V =$ their (b)(ii) / 2 **and** 0.0	judge by eye this mark may be awarded if all points shown including these points are correct even if no line is drawn N.B. a curve scores **0** marks	1 1 dep
(c)	temperature <u>increases</u>	accept filament lamp / it gets <u>hotter</u> allow heat for temperature	1
total			8

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4.6.2.1 Types of electromagnetic waves

3451F Q11

question	answers	extra information	mark
(a)(i)	gamma rays	accept gamma accept correct symbol	1
(ii)	infra red	accept IR	1
(b)	ultraviolet <u>absorbed</u> by ink (energy) given out as light	 accept glows / luminous accept for **both** marks the ink is fluorescent do **not** accept answers in terms of uv being reflected	1 1
(c)	any **two** from: • UV can damage / kill / ionise / alter (normal) cells • change DNA structure **or** mutate • (normal) cells may become cancerous	 do **not** accept attacks cells **or** burns skin accept may cause (skin) cancer accept abnormal cell multiplication	2
(d)(i)	microwaves **and** infra red	both answers needed in either order do **not** accept heat for IR	1
(ii)	0.9	allow **1** mark for the <u>correct</u> use of 1.8 (kW) $(1.8 \times \frac{1}{2}$ or $1.8 \times 30)$ i.e. adding the correct 2 power values	2
total			9

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4.6.2.1 Types of electromagnetic waves

3451F Q12

question	answers	extra information	mark
(a)(i)	accelerating	accept getting faster accept speed / velocity increasing	1
(ii)	acceleration <u>increases</u>	accept velocity / speed increases <u>more</u> rapidly do **not** accept velocity / speed increases	1
(b)(i)	$\text{acceleration} = \frac{\text{change in velocity}}{\text{time (taken)}}$	accept $a = \frac{v - u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ do **not** accept velocity for change in velocity do **not** accept change in speed do **not** accept $a = \frac{v}{t}$	1
(ii)	15	allow **1** mark for an answer of 900 **or** for <u>correct</u> use of 540 seconds	2
(iii)	velocity includes direction	accept velocity is a vector (quantity) accept converse answer	1
(c)	force of gravity (between <u>shuttle</u> and Earth) plus correct orbital speed (makes <u>shuttle</u> move in a curve)	accept gravitational pull if used correctly accept forward motion **or** constant speed for orbital speed accept it is travelling fast enough accept for **2** marks the force of gravity provides the <u>centripetal</u> force	1 1
(d)	black is a good emitter of radiation **or** to limit the temperature rise inside the shuttle	accept heat for radiation accept the tiles are good insulation do **not** accept black absorbs heat on its own do **not** accept tiles are heat proof	1
total			9

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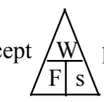
4.6.2.1 Types of electromagnetic waves

3451F Q13

question	answers	extra information	mark
(a)(i)	work (done) = force (applied) × distance (moved)	accept W = F × s or W = F × d accept  provided subsequent method is correct	1
(ii)	240 000 joules	allow **1** mark for correct substitution **or** correct use of 1200 (N) accept J do **not** accept j / Nm	2 1
(b)	800 (watts)	accept 0.8 kW accept their (a)(ii) ÷ 300 correctly evaluated for **2** marks allow **1** mark for correct substitution (a)(ii) ÷ 5 correctly evaluated for **1** mark	2
(c)(i)	any **one** from: • needs to raise the chair / lift • lifting more than one chair • energy transfer to the surroundings correctly qualified	 allow lifting more than 2 people implication of a heavier weight accept loss for transfer do **not** accept motor inefficient do **not** accept motor gets hot do **not** accept friction unless the location is specified as external to the motor	1
(ii)	electrical potential	accept electric **both** answers required for the mark	1
total			8

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4.6.2.1 Types of electromagnetic waves

3451F Q14

	answers	extra information	mark
(a)(i)	current		1
(ii)	resistance decreases	 accept 'the flow of electrons / current (through it) increases' for **1** mark do **not** credit just '… it will get warmer'	1 1
(b)	input sensor → controlled by the processor processor → detects changes in the environment output device → decides what action is needed	all pairs correct one pair correct for **1** mark	2
(c)(i)	potential divider	accept voltage divider	1
(ii)	4 (volts)	$6 \times \frac{30}{45}$ for **1** mark	2
(iii)	across the new resistor…(will) increase across R_2 … (will) decrease	 N.B. independent marks	1 1
total			10

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4.6.2.1 Types of electromagnetic waves

3451F Q15

	answers	extra information	mark
(a)	relay (normally open) (switch)	each mark is independent	1
	… switch on a (larger) current (in another circuit) **or** switch on a higher voltage circuit	do **not** accept switch on another circuit **or** smaller / equal current	1
	light emitting diode / LED	do **not** credit LDR	1
	… in one / direct / certain direction **or** from left to right	**or** when the cathode is connected to the negative terminal / side **or** when the left-hand side is connected to the positive terminal / side do **not** credit just '… is big enough' do **not** accept 'positive direction'	1
	AND gate	accept 'and' gate	1
	… (both) inputs are on / high / 1 **or** current flows in both inputs	do **not** accept numerical values unless expanded	1
(b)	**Quality of written communication**	If in a sensible order which clearly indicates advantages or disadvantages, including answers in the form of a table **or** as bullet points Q ✓ Q X	1
	any **three** from: • advantage of mobile phones • drawback of mobile phones • benefit of the Internet • drawback of the Internet	 e.g. more convenient for service engineers e.g. calls can be received away from base e.g. privacy can be more easily invaded e.g. drivers can be distracted e.g. microwaves / radio waves can / may cause damage to the brain e.g. access to educational material e.g. some material is salacious e.g. spam (on external e-mail) these are examples candidates may be credited for a variety of responses	3
total			10

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4.6.2.1 Types of electromagnetic waves

3451F Q16

question	answers	extra information	mark
(a)	**Y** and **Z**		1
	they have the same number of protons **or** same atomic number	accept they have the same number of electrons **or** same number of protons **and** electrons allow only different in number of neutrons N.B. independent marks	1
(b)	**Quality of written communication**	for correct use of terms underlined in B **or** C Q ✓ Q X	1
	A – alpha particle passes straight through the empty space of the atom **or** it is a long way from the nucleus B – alpha particle <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> by the (positive) <u>nucleus</u> C – alpha particle heading straight for the <u>nucleus</u> is <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> backwards	describes 3 tracks correctly for **2** marks describes 2 or 1 track correctly for **1** mark do **not** accept hits the nucleus do **not** accept answers referring to refraction do **not** accept answers in terms of reflected backwards unless qualified in terms of repulsion mention of difference in charge on nucleus negates that track	max 2
total			5

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GCSE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Science: Double Award
Specification B (Co-ordinated)
3462/3F

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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4.6.2.1 Types of electromagnetic waves

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4.6.2.1 Types of electromagnetic waves

SCIENCE: DOUBLE AWARD CO-ORDINATED

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

- the marks available for each part of the question;
- the total marks available for the question;
- the typical answer or answers which are expected;
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:
where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Where *Quality of written communication* appears in the mark scheme, one mark is to be awarded for either of the following points:

- Using correct scientific terms
- Correct sequencing or linking of ideas or points

The mark scheme will specify which of the points is to be awarded in a particular question. A QoWC mark can be awarded for a scientific answer, even if it is not accurate. It cannot be awarded for a nonsensical or non-scientific answer.
On the script, the QoWC tick should be identified by a 'q' written next to it.

3.2 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

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Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

If a candidate writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.
However:

- if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column;
- if the answer is correct, but an incorrect relationship is written in the working, then no marks can be awarded (see 3.5.2).

3.5.2 Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

3.6 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

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4.6.2.1 Types of electromagnetic waves

3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.8 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.9 Brackets

(…..) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.10 Interpretation of marginal points

There will be times when the answer is almost, but not quite, correct. Some examiners would award a mark while others would not. In any one script, an attempt should be made to balance these nearly correct answers by giving the mark on some occasions but not on others. If this is not done, the marking would end up being too lenient or too harsh.

3.11 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

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4.6.2.1 Types of electromagnetic waves

Double Award
Foundation Tier 3462/3F

3462/3F Q1

question	answers	extra information	mark
(a)	comet	correct order only	1
	elliptical		1
	Milky Way		1
	Universe		1
(b)(i)	D A C B	allow **2** marks for two letters in the correct place allow **1** mark for one letter in the correct place	3
(ii)	A		1
total			8

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4.6.2.1 Types of electromagnetic waves

3462/3F Q2

question	answers	extra information	mark
(a)	95		1
(b)	alpha	accept correct symbol	1
(c)	any **two** from: • radiation is outside the body • radiation will not reach (living) cells • radiation absorbed by the air	 accept detector is on ceiling or high up the wall accept radiation cannot pass through the body / skin accept cannot pass through the plastic casing do **not** accept because it is alpha radiation – unless qualified do **not** accept does not give off harmful substance do **not** accept cannot pass through building materials etc.	2
(d)	less (than)		1
total			5

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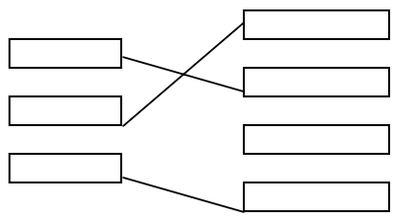
4.6.2.1 Types of electromagnetic waves

3462/3F Q3

question	answers	extra information	mark
(a)	generator	accept dynamo accept alternator	1
(b)(i)	1400	ignore units	1
(ii)	0.3 or 30%	any incorrect unit penalise **1** mark allow **1** mark for the correct use of 600 **or** 0.3% **or** 30	2
(c)	**1** mark for each correct link 	if more than 3 lines are drawn, mark only 3 lines starting with those that are incorrect	3
(d)(i)	110	no tolerance	1
(ii)	12	no tolerance	1
(iii)	wind speed may be too low to operate the generator	accept wind may not always blow accept power depends on wind speed accept does not generate if wind speed is too high accept does not generate if wind speed is above 12 (m/s) accept does not generate if wind speed is below 1.6 (m/s) accept it is unreliable do **not** accept answers referring to cost only	1
total			10

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4.6.2.1 Types of electromagnetic waves

3462/3F Q4

question	answers	extra information	mark
(a)	B E A D	allow **1** mark for each letter in the correct place, to a maximum of **3** marks	3
(b)	(a spark) may cause the (petrol vapour) to explode / ignite	accept petrol for (petrol vapour) accept catch fire for explode	1
	connect tanker to earth with a (conducting) wire / chain **or** earth the tanker	accept ground for earth	1
(c)	**Quality of written communication**	for a logical sequence	1
	any **two** from:		2
	• when current greater than fuse rating / value	accept when current too great for appliance do **not** accept 'if there is too much current' do **not** accept voltage or electricity	
	• fuse (becomes hot and) melts / burns out	accept fuse blows / breaks	
	• circuit is broken	accept circuit switched off this cannot score credit on its own	
total			8

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4.6.2.1 Types of electromagnetic waves

3462/3F Q5

question	answers	extra information	mark
(a)(i)	crust		1
(ii)	inner core is <u>solid</u> outer core is liquid	do **not** accept just rock inner core is denser / hotter than outer core gets **2** marks accept one is solid and one is liquid for **1** mark accept they are different densities for **1** mark wrong way round = **0** marks	1 1
(b)	seismograph		1
(c)	difficult to measure (slow) movement (1) of plates (1) dependent mark **or** difficult to measure friction / forces (1) between plates (1) dependent mark		1 1
(d)	geothermal		1
(e)(i)	5000		1
(ii)	2500		1
total			9

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4.6.2.1 Types of electromagnetic waves

3462/3F Q6

question	answers	extra information	mark
(a)	60		1
(b)	$5\frac{1}{2}$ hours	must include unit	1
(c)	30		1
(d)	30 minutes or $\frac{1}{2}$ hour	must include unit	1
(e)	D **and** E least steep part of the graph	accept finish for E accept correct numbers from axes with units accept covers smallest distance in a set time accept only moves 5 km in $1\frac{1}{2}$ hours (accept anything between 5 and 6) ignore horse is tired	1 1
total			6

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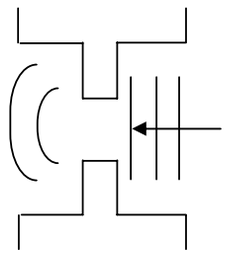
4.6.2.1 Types of electromagnetic waves

3462/3F Q7

question	answers	extra information	mark
(a)(i)	any **one** from: • (doctors) to see inside a patients body **or** endoscope • telephone cables • optical fibre / fibre optic lamps **or** (artificial) Christmas trees • data transfer **or** internet connection	 accept keyhole surgery do **not** accept flex **or** wires for cable accept decorative / ornamental lighting accept any feasible practical suggestion for taking light to a difficult to access place do **not** accept lighting unqualified do **not** accept lamp unqualified do **not** accept communications unless clarified	1
(ii)	(incident) ray angle greater than critical angle total internal reflection occurs	either order accept (incident) ray greater than 42° accept TIR do **not** accept just description of TIR	1 1
(b)(i)	waves shown diffracting in the correct direction 	ignore wavelength	1
(ii)	diffraction	accept diffract / diffracted	1
total			5

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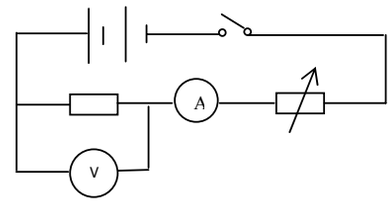
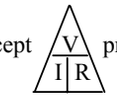
4.6.2.1 Types of electromagnetic waves

3462/3F Q8

question	answers	extra information	mark
(a)	all symbols correct	 accept push switch symbol switch may be open or closed any lines through symbols = **0** marks	1
	correct circuit drawn voltmeter must be across resistor only	polarity of cells not relevant provided they are joined correctly two cells are required in the diagram ignore the order of the components allow small gaps in circuit omission of any component = **0** marks	1
(b)(i)	potential difference = current × resistance	accept voltage or p.d. for potential difference accept $V = I \times R$ accept  provided subsequent use correct do **not** accept C for current	1
(ii)	2	 allow **1** mark for correct substitution wrong working loses both marks	2
(iii)	straight line drawn <u>through the origin</u> straight line passes through $I = 0.4, V =$ their (b)(ii) / 2 **and** 0.0	judge by eye this mark may be awarded if all points shown including these points are correct even if no line is drawn N.B. a curve scores **0** marks	1 1 dep
(c)	temperature <u>increases</u>	accept filament lamp / it gets <u>hotter</u> allow heat for temperature	1
total			8

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4.6.2.1 Types of electromagnetic waves

3462/3F Q9

question	answers	extra information	mark
(a)(i)	gamma rays	accept gamma accept correct symbol	1
(ii)	infra red	accept IR	1
(b)	ultraviolet <u>absorbed</u> by ink (energy) given out as light	 accept glows / luminous accept for **both** marks the ink is fluorescent do **not** accept answers in terms of uv being reflected	1 1
(c)	any **two** from: • UV can damage / kill / ionise / alter (normal) cells • change DNA structure **or** mutate • (normal) cells may become cancerous	 do **not** accept attacks cells **or** burns skin accept may cause (skin) cancer accept abnormal cell multiplication	2
(d)(i)	microwaves **and** infra red	both answers needed in either order do **not** accept heat for IR	1
(ii)	0.9	allow **1** mark for the <u>correct</u> use of 1.8 (kW) $(1.8 \times \frac{1}{2}$ or $1.8 \times 30)$ i.e. adding the correct 2 power values	2
total			9

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4.6.2.1 Types of electromagnetic waves

3462/3F Q10

question	answers	extra information	mark
(a)(i)	accelerating	accept getting faster accept speed / velocity increasing	1
(ii)	acceleration increases	accept velocity / speed increases more rapidly do **not** accept velocity / speed increases	1
(b)(i)	$\text{acceleration} = \frac{\text{change in velocity}}{\text{time (taken)}}$	accept $a = \frac{v - u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ do **not** accept velocity for change in velocity do **not** accept change in speed do **not** accept $a = \frac{v}{t}$	1
(ii)	15	allow **1** mark for an answer of 900 **or** for correct use of 540 seconds	2
(iii)	velocity includes direction	accept velocity is a vector (quantity) accept converse answer	1
(c)	force of gravity (between shuttle and Earth) plus correct orbital speed (makes shuttle move in a curve)	accept gravitational pull if used correctly accept forward motion **or** constant speed for orbital speed accept it is travelling fast enough accept for **2** marks the force of gravity provides the centripetal force	1 1
(d)	black is a good emitter of radiation **or** to limit the temperature rise inside the shuttle	accept heat for radiation accept the tiles are good insulation do **not** accept black absorbs heat on its own do **not** accept tiles are heat proof	1
total			9

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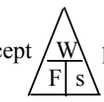
4.6.2.1 Types of electromagnetic waves

3462/3F Q11

question	answers	extra information	mark
(a)(i)	work (done) = force (applied) × distance (moved)	accept W = F × s or W = F × d accept  provided subsequent method is correct	1
(ii)	240 000 joules	allow **1** mark for correct substitution **or** correct use of 1200 (N) accept J do **not** accept j / Nm	2 1
(b)	800 (watts)	accept 0.8 kW accept their (a)(ii) ÷ 300 correctly evaluated for **2** marks allow **1** mark for correct substitution (a)(ii) ÷ 5 correctly evaluated for **1** mark	2
(c)(i)	any **one** from: • needs to raise the chair / lift • lifting more than one chair • energy transfer to the surroundings correctly qualified	 allow lifting more than 2 people implication of a heavier weight accept loss for transfer do **not** accept motor inefficient do **not** accept motor gets hot do **not** accept friction unless the location is specified as external to the motor	1
(ii)	electrical potential	accept electric **both** answers required for the mark	1
total			8

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4.6.2.1 Types of electromagnetic waves

3462/3F Q12

question	answers	extra information	mark
(a)	**Y** and **Z**		1
	they have the same number of protons **or** same atomic number	accept they have the same number of electrons **or** same number of protons **and** electrons allow only different in number of neutrons N.B. independent marks	1
(b)	**Quality of written communication**	for correct use of terms underlined in B **or** C Q ✓ Q X	1
	A – alpha particle passes straight through the empty space of the atom **or** it is a long way from the nucleus B – alpha particle <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> by the (positive) <u>nucleus</u> C – alpha particle heading straight for the <u>nucleus</u> is <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> backwards	describes 3 tracks correctly for **2** marks describes 2 or 1 track correctly for **1** mark do **not** accept hits the nucleus do **not** accept answers referring to refraction do **not** accept answers in terms of reflected backwards unless qualified in terms of repulsion mention of difference in charge on nucleus negates that track	max 2
total			5

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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Physics 3451/F
Specification B

Mark Scheme

2005 examination – June series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

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4.6.2.1 Types of electromagnetic waves

Physics (Specification B)
Foundation Tier 3451/F

3451/F Q1

question	answers	extra information	mark
(a)(i)	less than	accept any correct indication	1
(ii)	more than	accept any correct indication	1
(b)	any **two** from: stays above the same place above the equator one orbit takes 24 hours	 do **not** accept stays in the same place do **not** accept goes around equator unless qualified do **not** accept orbit at same speed as Earth do **not** accept orbit at a constant speed accept has same angular speed / velocity as Earth	2
total			4

3451/F Q2

question	answers	extra information	mark
(a)	comet		1
(b)	large group / number / collection of stars	ignore reference to planets accept millions of stars do **not** accept thousands of stars do **not** accept loads of stars	1
(c)	giant supernova neutron		1 1 1
total			5

4.6.2.1 Types of electromagnetic waves

3451/F Q3

question	answers	extra information	mark
(a)(i)	radio		1
(ii)	gamma	accept microwave accept infrared	1
(iii)	ultra violet		1
(iv)	microwaves		1
(b)	the same as		1
(c)	X-rays do not go through lead	references to gamma rays are incorrect accept lead protects them from the X-rays accept not exposed to X-rays	1
	lead stops / reduces risk of X-rays harming / damaging / killing (persons) <u>cells</u>	accept X-rays (may) cause cancer accept organs for cell do **not** accept references to electric shock do **not** accept stops bones of people showing on X-ray answers involving the horse wearing an apron are incorrect	1
	Quality of written communication	award for a sensible sequence of **two** points	1
total			8

4.6.2.1 Types of electromagnetic waves

3451/F Q4

question	answers	extra information	mark
(a)	light electrical		1 1
(b)	15% **or** 0.15	correct substitution gains **1** mark only an answer of 15 with no unit **or** an incorrect unit gains **1** mark an answer of 0.15 given with a unit gains **1** mark	2
(c)	the ticket machine is a long way from other electricity supplies		1
(d)	any figure between 5 and 10 inclusive	unit not required but if given must match numerical answer	1
total			6

3451/F Q5

question	answers	extra information	mark
(a)(i)	radon (gas)	do **not** accept gas	1
(ii)	background		1
(b)	bigger	accept any word which means bigger	1
(c)	**Z** alpha will not pass through aluminium or lead	if Z is not given, the reason does not score accept alpha cannot go through metals / dense material accept there is nothing to stop the radiation accept alpha will not pass through aluminium do **not** accept alpha will not pass through lead do **not** accept alpha stopped by air	1 1
total			5

4.6.2.1 Types of electromagnetic waves

3451/F Q6

question	answers	extra information	mark
(a)	loses negative charge / electrons	do **not** accept positive charge transfers to the comb do **not** accept friction	1
(b)	**A** attract		1
	B repel		1
	C attract		1
(c)	**F A D E**	allow **2** marks for 2 letters in the correct place allow **1** mark for 1 letter in the correct place	3
total			7

4.6.2.1 Types of electromagnetic waves

3451/F Q7

question	answers	extra information	mark
(a)	all points correctly plotted	tolerance ± $\frac{1}{2}$ square on y axis only allow **1** mark for 3 correctly plotted points	2
	attempt made to draw a smooth curve	do **not** accept dot-to-dot line	1
(b)(i)	3 days ± 0.2 **or** any value correctly obtained using their graph line	if no line drawn in (a), answer must be exactly 3	1
(ii)	3 days or their (b)(i)		1
(c)	radon-222	accept radon **or** 222 accept alpha or 3.8 correct isotope required for reason to score	1
	has the shortest half-life	accept the others have longer half-lives	1
total			7

4.6.2.1 Types of electromagnetic waves

3451/F Q8

question	answers	extra information	mark
(a)	fossils of Cynognathus are found in Africa and South America		1
	the shapes ……. almost fit together	only two boxes should be ticked deduct **1** mark for each additional box to a minimum mark of **0**	1
(b)	continental		1
	crust		1
	tectonic		1
total			5

4.6.2.1 Types of electromagnetic waves

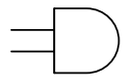
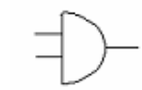
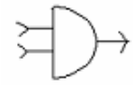
3451/F Q9

question	answers	extra information	mark
(a)	capacitor	accept condenser	1
	LDR	**or** light dependent resistor accept 'ldr', 'Ldr' etc.	1
	relay (normally open)	do **not** accept 'relay normally closed'	1
(b)(i)	battery	accept '(battery of) cells' do **not** accept 'battery / cell'	1
(ii)	LED	**or** light emitting diode accept 'led' or 'Led' do **not** accept just 'diode'	1
(iii)	B will light (but C will not)	accept '(only) B will work' accept 'one is on the other is off' do **not** accept 'C is on and B is off'	1
(iv)	any **one** from: B is connected the right way round (and C is not) a (light emitting) diode only allows (a significant) current to flow in one direction B's anode is connected to the positive side of the supply B's cathode is connected to the negative terminal	N.B. the candidate's answer to part (b)(iii) may include this mark but do **not** credit if the response to part (b)(iii) is incorrect or there is any other contradiction if (iv) is completely consistent with (iii) which is wrong, allow **1** mark	1
(c)(i)	first input / second input / output 0 / 0 / **0** 1 / 0 / **0** 0 / 1 / **0** 1 / 1 / **1**	**all** correct allow: OFF NO OFF NO OFF NO ON YES	1
(ii)	truth (table)		1

cont…

4.6.2.1 Types of electromagnetic waves

3451/F Q9 cont…

(iii)		a Roman upper case D in any orientation without contacts is acceptable but if contacts are shown do **not** give the mark if there is any ambiguity or contradiction allow  	1
(d)	light sensor	**or** light dependent resistor **or** LDR accept 'ldr', Ldr' etc allow solar cell, photo cell	1
	NOT gate	accept 'Not gate' **or** 'not gate' if both correct but in the wrong order credit with **1** mark	1
total			12

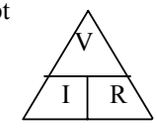
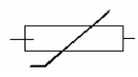
4.6.2.1 Types of electromagnetic waves

3451/F Q10

question	answers	extra information	mark
(a)(i)	rays continued to meet on the right hand side of the lens and beyond	must be straight lines from the right hand side of the lens ignore details through the lens allow if no arrows	1
	meet exactly on the axis	negate mark if contradictory arrow(s) added do not need to go beyond the focus for this mark	1
(ii)	(principal) focus	**or** focal (point)	1
(iii)	converging	**or** convex	1
(b)(i)	**A**		1
(ii)	rays seem to come from this point	**or** words to this effect **or** shows this on the diagram	1
(iii)	diverging	**or** concave	1
(c)	film	accept any unambiguous method of showing the correct response	1
	smaller than		1
	further away from		1
(d)	any **three** from: • real image can be put on a screen • virtual image cannot be put on a screen / film • virtual image is imaginary • real image is formed where (real) rays cross / converge • virtual image is where virtual / imaginary rays (seem to) come from • virtual image formed where virtual rays intersect / cross	allow film allow real image has light travelling through it **or** virtual image is where rays seem to come from	3
total			13

4.6.2.1 Types of electromagnetic waves

3451/F Q11

question	answers	extra information	mark
(a)(i)	$A_1 = 0.5$	ignore any units	1
	$A_4 = 0.5$	allow **1** mark for $A_1 = A_4 \neq 0.5$	1
(ii)	the resistance of **P** is more than 20 Ω		1
	a smaller current goes through P / A_2 (than 20 Ω)	dependent on getting 1st mark correct accept converse	1
(b)(i)	potential difference = current × resistance	accept pd / voltage for potential difference accept V = I × R, correct symbols and correct case only accept volts = amps × ohms accept  provided subsequent method is correct allow combination of physical quantities and named units allow voltage = I × R	1
(ii)	6	allow **1** mark for correct substitution	2
(iii)	6	accept their (b)(ii)	1
(c)	thermistor or 	accept correct circuit symbol allow phonetic spelling	1
	resistance goes down (as temperature of thermistor goes up)	do **not** accept changes for goes down do **not** accept an answer in terms of current only answers in terms of other components are incorrect	1
total			10

4.6.2.1 Types of electromagnetic waves

3451/F Q12

question	answers	extra information	mark
(a)(i)	larger the distance, greater the time	accept 'they are proportional' accept converse	1
(ii)	any value between 6 and 9 years inclusive		1
(b)(i)	carbon dioxide		1
(ii)	(Venus) has high**er** temperature (than Mercury)	accept has the high**est** temperature accept Venus is hotter / hottest do **not** accept has a high / very high temperature	1
	(Venus) further from the Sun than Mercury	accept 'Venus is not the closest planet to the Sun' answer in terms of greenhouse effect only, scores **0** marks	1
total			5

4.6.2.1 Types of electromagnetic waves

3451/F Q13

question	answers	extra information	mark
(a)(i)	20		1
(ii)	convection		1
(iii)	fit draughtproof strips	accept lay carpet accept fit curtains accept close doors / windows / curtains accept any reasonable suggestion for reducing a draught 'double glazing' alone is insufficient	1
(b)	air is (a good) insulator **or** air is a poor conductor	accept air cavity / 'it' for air	1
	reducing heat transfer by <u>conduction</u>	accept stops for reduces ignore convection do **not** accept radiation do **not** accept answers in terms of heat being trapped	1
(c)(i)	most cost effective	accept it is cheaper or low<u>est</u> cost accept shortest payback time accept in terms of reducing heat loss by the largest amount do **not** accept it is easier ignore most heat is lost through the roof	1
(ii)	4		1
total			7

4.6.2.1 Types of electromagnetic waves

3451/F Q14

question	answers	extra information	mark
(a)(i)	constant speed	do **not** accept normal speed do **not** accept it is stopped / stationary	1
	in a straight line	accept any appropriate reference to a direction constant velocity gains **2** marks 'not accelerating' gains **2** marks terminal velocity alone gets **1** mark	1
(ii)	goes down owtte	accept motorbike (it) slows down	1
(b)(i)	20 (m/s)	ignore incorrect units	1
(ii)	acceleration = change in velocity / time (taken)	do **not** accept velocity for change in velocity accept change in speed accept $a = \frac{v-u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ **or** a = $\frac{\Delta v}{t}$ do **not** accept $a = \frac{v}{t}$	1
(iii)	4 **or** their (b)(i) ÷ 5	allow **1** mark for correct substitution	2
	m/s^2	m/s/s **or** ms^{-2} **or** metres per second squared **or** metres per second per second	1
(c)	vehicle may skid / slide	loss of control / brakes lock / wheels lock accept greater stopping distance **or** difficult to stop	1
	due to reduced friction (between tyre(s) and road)	accept due to less grip do **not** accept no friction	1

cont…

4.6.2.1 Types of electromagnetic waves

3451/F Q14 cont…

(d)	any **three** from: • <u>increased</u> speed • <u>reduced</u> braking force • <u>slower</u> (driver) reactions • <u>poor</u> vehicle maintenance • <u>increased</u> mass / weight of vehicle • <u>poor</u> road surface • <u>more</u> streamlined	do **not** accept night time / poor vision N.B. specific answers may **each** gain credit eg tiredness (1), drinking alcohol (1), using drugs (1), driver distracted (1) etc specific examples may **each** gain credit eg worn brakes or worn tyres etc accept large mass / weight of vehicle if candidates give three answers that affect stopping distance but not specific to <u>increase</u> award **1** mark only	3
total			13

4.6.2.1 Types of electromagnetic waves

3451/F Q15

question	answers	extra information	mark
(a)(i)	arrow from centre of the ball **and** at right angles to the string **and** in the correct direction	arrow should point to the student's belt accept free-hand 'straight' line do **not** accept curved line	1
(ii)	increase increase increase	accept 'be stronger / bigger' accept 'be stronger / bigger' accept 'be stronger / bigger'	1 1 1
(b)	speed velocity direction	all **three** correct any two correct for **1** mark otherwise **0** marks	2
(c)(i)	centripetal	accept 'centripedal' and other minor misspellings do **not** accept anything which could be 'centrifugal'	1
(ii)	gravity	accept 'weight' accept 'force of attraction due to mass(es) (of the Moon and the Earth)'	1
(iii)	electron(s)		1
(iv)	electrostatic	accept 'electrical' do **not** accept just 'centripetal'	1
total			10

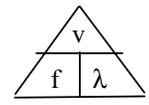
4.6.2.1 Types of electromagnetic waves

3451/F Q16

question	answers	extra information	mark
(a)(i)	**X** at the centre of the lifebelt	measuring from the centre of **X**, allow 2 mm tolerance in any direction	1
(ii)	any **two** from: below the point of suspension at the centre (of the lifebelt) (because) the lifebelt / it is symmetrical	if X is on vertical line below the hanger (but not at centre) can gain the first point only accept '(vertically) below **Y**' accept 'in the middle' **or** (because) the mass / weight is evenly distributed	2
(b)	Nm **or** newton metre(s) 750	accept Newton metre(s) do **not** accept any ambiguity in the symbol ie NM, nM or nm (moment) = force × (perpendicular) distance (between line of action and pivot) **or** (moment) = 500 × 1.5 gains **1** mark	1 2
(c)	**Quality of written communication**: any **three** connected points from: low(er) <u>centre of mass / gravity</u> (more) <u>stable</u> less likely to fall over the <u>turning effect / moment</u> (of the weight of case) is less so the pull on her arm is less	for **2** of the underlined terms used in the correct context **or** <u>centre of mass / gravity</u> will be close(r) to the wheels / axle / ground **or** less <u>unstable</u> accept 'less likely to overturn' do **not** accept 'will not fall over' **or** so less effort is needed to hold the case ignore references to pulling the case	1 3
total			10

4.6.2.1 Types of electromagnetic waves

3451/F Q17

question	answers	extra information	mark
(a)	any **two** from: • **amplitude** decreasing • **wavelength** increasing • **frequency** decreasing **Quality of written communication**	accept siren / sound getting quieter do **not** accept sound decreases accept pitch decreasing ignore reference to transverse wave ignore reference to speed contradictory statements within each point lose the mark all emboldened terms in candidate's answer used correctly	2 1
(b)(i)	ultrasound **or** ultrasonic		1
(ii)	wave speed = frequency × wavelength	accept speed / velocity for wave speed accept $v = f \times \lambda$ do **not** accept w for λ do **not** accept s for v accept  provided subsequent calculation shows a correct method	1
(iii)	339.2 **or** 340 **or** 339	allow **1** mark for using 212 000 allow **1** mark for correct substitution an answer of 0.3392 **or** 0.34 **or** 0.339 gains **1** mark only award full credit for a correct numerical answer with the unit changed to km/s	3
total			8

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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Science: Double Award 3462/3F
Specification B (Co-ordinated)

Mark Scheme

2005 examination - June series

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4.6.2.1 Types of electromagnetic waves

Double Award
Foundation Tier 3462/3F

3462/3F Q1

question	answers	extra information	mark
(a)(i)	less than	accept any correct indication	1
(ii)	more than	accept any correct indication	1
(b)	any **two** from: stays above the same place above the equator one orbit takes 24 hours	 do **not** accept stays in the same place do **not** accept goes around equator unless qualified do **not** accept orbit at same speed as Earth do **not** accept orbit at a constant speed accept has same angular speed / velocity as Earth	2
total			4

3462/ 3F Q2

question	answers	extra information	mark
(a)	comet		1
(b)	large group / number / collection of stars	ignore reference to planets accept millions of stars do **not** accept thousands of stars do **not** accept loads of stars	1
(c)	giant supernova neutron		1 1 1
total			5

4.6.2.1 Types of electromagnetic waves

3462/3F Q3

question	answers	extra information	mark
(a)(i)	radio		1
(ii)	gamma	accept microwave accept infrared	1
(iii)	ultra violet		1
(iv)	microwaves		1
(b)	the same as		1
(c)	**Quality of written communication**	award for a sensible sequence of **two** points	1
	X-rays do not go through lead	accept lead protects them from the X-rays accept not exposed to X-rays	1
	lead stops / reduces risk of X-rays harming / damaging / killing (persons) <u>cells</u>	accept X-rays (may) cause cancer accept organs for cell do **not** accept references to electric shock do **not** accept stops bones of people showing on X-ray answers involving the horse wearing an apron are incorrect references to gamma rays are incorrect	1
total			8

4.6.2.1 Types of electromagnetic waves

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q4

question	answers	extra information	mark
(a)	light electrical		1 1
(b)	15% **or** 0.15	correct substitution gains **1** mark only an answer of 15 with no unit **or** an incorrect unit gains **1** mark an answer of 0.15 given with a unit gains **1** mark	2
(c)	the ticket machine is a long way from other electricity supplies		1
(d)	any figure between 5 and 10 inclusive	unit not required but if given must match numerical answer	1
total			6

4.6.2.1 Types of electromagnetic waves

3462/3F Q5

question	answers	extra information	mark
(a)(i)	radon (gas)	do **not** accept gas	1
(ii)	background		1
(b)	bigger	accept any word which means bigger	1
(c)	**Z** alpha will not pass through aluminium or lead	if Z is not given, the reason does not score accept alpha cannot go through metals / dense material accept there is nothing to stop the radiation accept alpha will not pass through aluminium do **not** accept alpha will not pass through lead do **not** accept alpha stopped by air	1 1
total			5

4.6.2.1 Types of electromagnetic waves

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q6

question	answers	extra information	mark
(a)	loses negative charge / electrons	do **not** accept positive charge transfers to the comb do **not** accept friction	1
(b)	**A** attract		1
	B repel		1
	C attract		1
(c)	**F A D E**	allow **2** marks for 2 letters in the correct place allow **1** mark for 1 letter in the correct place	3
total			7

4.6.2.1 Types of electromagnetic waves

3462/3F Q7

question	answers	extra information	mark
(a)	all points correctly plotted	tolerance ± $\frac{1}{2}$ square on y axis only allow **1** mark for 3 correctly plotted points	2
	attempt made to draw a smooth curve	do **not** accept dot-to-dot line	1
(b)(i)	3 days ± 0.2 **or** any value correctly obtained using their graph line	if no line drawn in (a), answer must be exactly 3	1
(ii)	3 days or their (b)(i)		1
(c)	radon-222	accept radon **or** 222 accept alpha or 3.8 correct isotope required for reason to score	1
	has the shortest <u>half-life</u>	accept the others have longer <u>half-lives</u>	1
total			7

4.6.2.1 Types of electromagnetic waves

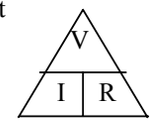
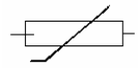
Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q8

question	answers	extra information	mark
(a)	fossils of Cynognathus are found in Africa and South America		1
	the shapes ……. almost fit together	only two boxes should be ticked deduct **1** mark for each additional box to a minimum mark of **0**	1
(b)	continental		1
	crust		1
	tectonic		1
total			5

4.6.2.1 Types of electromagnetic waves

3462/3F Q9

question	answers	extra information	mark
(a)(i)	$A_1 = 0.5$ $A_4 = 0.5$	ignore any units allow **1** mark for $A_1 = A_4 \neq 0.5$	1 1
(ii)	the resistance of **P** is more than 20 Ω a smaller current goes through P / A_2 (than 20 Ω)	 dependent on getting 1st mark correct accept converse	1 1
(b)(i)	potential difference = current × resistance	accept pd / voltage for potential difference accept V = I × R, correct symbols and correct case only accept volts = amps × ohms accept  provided subsequent method is correct allow combination of physical quantities and named units allow voltage = I × R	1
(ii)	6	allow **1** mark for correct substitution	2
(iii)	6	accept their (b)(ii)	1
(c)	thermistor or  resistance goes down (as temperature of thermistor goes up)	accept correct circuit symbol allow phonetic spelling do **not** accept changes for goes down do **not** accept an answer in terms of current only answers in terms of other components are incorrect	1 1
total			10

4.6.2.1 Types of electromagnetic waves

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q10

question	answers	extra information	mark
(a)(i)	larger the distance, greater the time	accept 'they are proportional' accept converse	1
(ii)	any value between 6 and 9 years inclusive		1
(b)(i)	carbon dioxide		1
(ii)	(Venus) has high**er** temperature (than Mercury)	accept has the high**est** temperature accept Venus is hotter / hottest do **not** accept has a high / very high temperature	1
	(Venus) further from the Sun than Mercury	accept 'Venus is not the closest planet to the Sun' answer in terms of greenhouse effect only, scores **0** marks	1
total			5

4.6.2.1 Types of electromagnetic waves

3462/3F Q11

question	answers	extra information	mark
(a)(i)	20		1
(ii)	convection		1
(iii)	fit draughtproof strips	accept lay carpet accept fit curtains accept close doors / windows / curtains accept any reasonable suggestion for reducing a draught 'double glazing' alone is insufficient	1
(b)	air is (a good) insulator **or** air is a poor conductor	accept air cavity / 'it' for air	1
	reducing heat transfer by <u>conduction</u>	accept stops for reduces ignore convection do **not** accept radiation do **not** accept answers in terms of heat being trapped	1
(c)(i)	most cost effective	accept it is cheaper or low<u>est</u> cost accept shortest payback time accept in terms of reducing heat loss by the largest amount do **not** accept it is easier ignore most heat is lost through the roof	1
(ii)	4		1
total			7

4.6.2.1 Types of electromagnetic waves

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q12

question	answers	extra information	mark
(a)(i)	constant speed	do **not** accept normal speed do **not** accept it is stopped / stationary	1
	in a straight line	accept any appropriate reference to a direction constant velocity gains **2** marks 'not accelerating' gains **2** marks terminal velocity alone gets **1** mark	1
(ii)	goes down owtte	accept motorbike (it) slows down	1
(b)(i)	20 (m/s)	ignore incorrect units	1
(ii)	acceleration = change in velocity / time (taken)	do **not** accept velocity for change in velocity accept change in speed accept $a = \frac{v-u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ **or** $a = \frac{\Delta v}{t}$ do **not** accept $a = \frac{v}{t}$	1
(iii)	4 **or** their (b)(i) ÷ 5	allow **1** mark for correct substitution	2
	m/s^2	m/s/s **or** ms^{-2} **or** metres per second squared **or** metres per second per second	1
(c)	vehicle may skid / slide	loss of control / brakes lock / wheels lock accept greater stopping distance **or** difficult to stop	1
	due to reduced friction (between tyre(s) and road)	accept due to less grip do **not** accept no friction	1

cont…

4.6.2.1 Types of electromagnetic waves

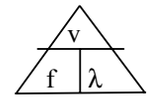
3462/3F Q12 cont…

(d)	any **three** from: • <u>increased</u> speed • <u>reduced</u> braking force • <u>slower</u> (driver) reactions • <u>poor</u> vehicle maintenance • <u>increased</u> mass / weight of vehicle • <u>poor</u> road surface • <u>more</u> streamlined	do **not** accept night time / poor vision NB specific answers may **each** gain credit eg tiredness (1), drinking alcohol (1), using drugs (1), driver distracted (1) etc specific examples may **each** gain credit eg worn brakes or worn tyres etc accept large mass / weight of vehicle if candidates give three answers that affect stopping distance but not specific to <u>increase</u> award **1** mark only	3
total			13

4.6.2.1 Types of electromagnetic waves

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q13

question	answers	extra information	mark
(a)	**Quality of written communication**	all emboldened terms in candidate's answer used correctly	1
	any **two** from: • **amplitude** decreasing • **wavelength** increasing • **frequency** decreasing	accept siren / sound getting quieter do **not** accept sound decreases accept pitch decreasing ignore reference to transverse wave ignore reference to speed contradictory statements within each point lose the mark	2
(b)(i)	ultrasound **or** ultrasonic		1
(ii)	wave speed = frequency × wavelength	accept speed / velocity for wave speed accept $v = f \times \lambda$ do **not** accept w for λ do **not** accept s for v accept  provided subsequent calculation shows a correct method	1
(iii)	339.2 **or** 340 **or** 339	allow **1** mark for using 212 000 allow **1** mark for correct substitution an answer of 0.3392 **or** 0.34 **or** 0.339 gains **1** mark only award full credit for a correct numerical answer with the unit changed to km/s	3
total			8

4.6.2.1 Types of electromagnetic waves

AQA

GCSE

Science A / Physics

PH1HP

Mark scheme

4405/4403
June 2015

Version/Stage: 1.0 Final

4.6.2.1 Types of electromagnetic waves

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Further copies of this mark scheme are available from aqa.org.uk

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4.6.2.1 Types of electromagnetic waves

Mark Scheme

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of errors / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

4.6.2.1 Types of electromagnetic waves

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.1 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.2 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.3 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.4 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.5 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.6 Brackets

(.....) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.2 Ignore / Insufficient / Do not allow

Ignore of insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

4. Quality of Communication and levels marking

In Question **2a** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic
- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear
- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed
- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar

4.6.2.1 Types of electromagnetic waves

Question	Answers	Extra information	Mark	AO / Spec. ref.
1(a)	chemical kinetic sound	correct order only	1 1 1	AO1 P1.2.1a
1(b)	37.5% or 0.375	an answer rounded to 0.38 or 38% scores both marks an answer of 0.375 with a unit gains **1** mark an answer of 0.375% gains **1** mark an answer of 37.5 with or without a unit gains **1** mark allow **1** mark for an answer 3/8 3/8 with a unit scores 0	2	AO2 P1.2.1d
Total			**5**	

4.6.2.1 Types of electromagnetic waves

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th><th>ID</th></tr>
<tr><td>2 (a)</td><td colspan="2">Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 4 and apply a ‘best-fit’ approach to the marking.</td><td>6</td><td>AO2
AO3
P1.2
HSW</td><td>E</td></tr>
<tr><td colspan="6">
<table>
<tr><th>0 marks</th><th>Level 1 (1-2 marks)</th><th>Level 2 (3-4 marks)</th><th>Level 3 (5-6 marks)</th></tr>
<tr><td>No relevant information</td><td>There is a relevant statement about an energy saving method</td><td>There is at least one clear comparison of energy saving methods and their cost effectiveness with an appropriate calculation</td><td>There is a comparison of energy saving methods and their cost effectiveness with appropriate calculations. Comparison to include further detail.</td></tr>
</table>
</td></tr>
<tr><td colspan="2">examples of physics points made in the response

examples of relevant statements
• energy efficient boiler saves the most (energy / money) per year
• loft insulation costs the least to install
• double-glazing costs the most to install

examples of statements that include cost effectiveness
• loft insulation is the most cost effective in the long term
• double-glazing is the least cost effective
• loft insulation has the shortest payback time
• double-glazing has the longest payback time
• payback time calculated for any method
examples of further detail
• for cost effectiveness install in the following order: loft, cavity wall, boiler, double-glazing
• for reducing energy use install in the following order: boiler, loft, cavity wall, double glazing
• don’t install double-glazing for insulation purposes
• double-glazing won’t pay for itself in your lifetime
• justified choice of best / worst method</td><td colspan="2">extra information

payback times:
energy efficient boiler: 6.25 years
loft insulation: 2 years
double glazing: 100 years
cavity wall insulation: 2.86 years</td><td></td><td></td></tr>
</table>

4.6.2.1 Types of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP – JUNE 2015

Question 2 continued . . .

Question	Answers	Extra information	Mark	AO / Spec. ref.
2(b)(i)	how effective a material is as an insulator	accept 'heat' for energy accept how effective a material is at keeping energy in accept the lower the U-value the better the insulator accept the lower the U-value the lower the rate of energy transfer	1	AO1 P1.1.4a
2(b)(ii)	(the U-value) decreases		1	AO1 P1.1.4b
Total			**8**	

4.6.2.1 Types of electromagnetic waves

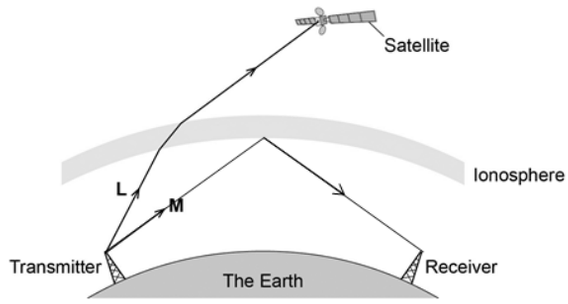
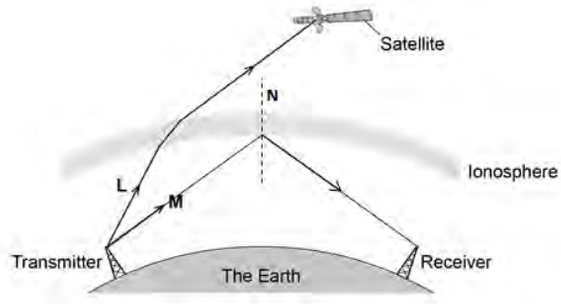
MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP – JUNE 2015

Question	Answers	Extra information	Mark	AO / Spec. ref.
3(a)(i)	0.5 °C		1	AO3 P1.1
3(a)(ii)	data is continuous **or** both variables are continuous **or** independent variable is continuous **or** time is continuous	accept results / measurements for data accept data is not categoric one variable is continuous is insufficient air temperature is continuous is insufficient	1	AO3 P1.1
3(b)(i)	20.5 (°C)		1	AO2 P1.1
3(b)(ii)	60 (minutes)	accept 1 hour	1	AO2 P1.1
3(c)(i)	so a comparison can be made **or** outside temperature is a control variable	accept: (outside) temperature would affect energy required (to maintain temperature of the house) **or** (outside) temperature would affect internal temperature (of the house) **or** heat loss will be faster on a cold day outside temperature will affect the results is insufficient fair test is insufficient	1	AO3 P1.1

Question 3 continues on the next page . . .

4.6.2.1 Types of electromagnetic waves

Question	Answers	Extra information	Mark	AO / Spec. ref.
3(c)(ii)	the cost is equal to the number of kWh x the cost per kWh calculation 0.8 / 8.0 = 0.1 or 10%	accept (heating) bill depends on (number of) kWh used accept energy for kWh allow 7.2 / 8.0 = 0.9 or 90%	1 1	AO3 AO2 P1.1
3(c)(iii)	heating is on for more / less time (than anticipated) because some days it is cooler / warmer (than anticipated)	 accept other sensible suggestions an answer giving two sensible situations gains **2** marks possible examples: • some houses have different amounts of insulation • there are different styles of house temperature (inside / outside) is always changing is insufficient	1 1	AO3 P1.1
Total			**9**	

Question	Answers	Extra information	Mark	AO / Spec. ref.
4(a)(i)	microwave		1	AO1 P1.5.1k
4(a)(ii)	refraction		1	AO1 P1.5.1g
4(b)(i)	wave M continues as a straight line to the ionosphere and shown reflected correctly reflected wave shown as a straight line reaching the top of the receiver  	accept reflection at or within the ionosphere if more than 2 rays shown 1 mark maximum ignore arrows	1 1	AO2 P1.5.2b
4(b)(ii)	normal drawn at point where their **M** meets the ionosphere  		1	AO1 P1.5.2a

Question 4 continues on the next page. . .

4.6.2.1 Types of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP – JUNE 2015

Question 4 continued…

Question	Answers	Extra information	Mark	AO / Spec. ref.
4(c)	any **two** from: • transverse • same speed (through air) • can be reflected • can be refracted • can be diffracted • can be absorbed • transfer energy • can travel through a vacuum • can be polarised • show interference	 accept speed of light **or** 3 x 10^8 m/s an answer travel at the same speed though a vacuum scores **2** marks travel in straight lines is insufficient	2	AO1 P1.5.1a,bc, d,g
Total			**7**	

4.6.2.1 Types of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP – JUNE 2015

Question	Answers	Extra information	Mark	AO / Spec. ref.
5(a)(i)	infrared (radiation)	accept IR (radiation)	1	AO1 P1.1.1b
5(a)(ii)	(heated) water turns to steam steam turns a turbine turbine turns a generator	ignore reference to fossil fuels do **not** accept water evaporates to steam accept turbine connected to a generator	1 1 1	AO1 P1.4.1a
5(b)(i)	(so the molten salts) can store large amounts of energy	accept there is a small temperature change for a large energy transfer accept heat for energy	1	AO2 P1.1.4d
5(b)(ii)	16 (hours)	an answer that rounds to 16 gains **2** marks eg 15.71 allow **1** mark for a correct substitution ie 2 200 000 = 140 000 x t	3	AO2 AO1 P1.3.1c
5(b)(iii)	the number of daylight hours varies the (mean) power (received from the Sun per square metre) varies	less sunlight is insufficient accept an answer in terms of maximum possible electrical output only possible during Summer for **1** mark	1 1	AO2 AO3 P1.4

Question 5 continues on the next page . . .

4.6.2.1 Types of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP – JUNE 2015

Question 5 continued . . .

Question	Answers	Extra information	Mark	AO / Spec. ref.
5(c)(i)	non-renewable power stations have higher Capacity Factors than renewable power stations		1	AO1 AO3 P1.4
	fuel (for non-renewable power stations) is always available	reference to non-renewable power stations operating all the time is insufficient non-renewable energy sources are reliable is insufficient	1	
	(most) renewable energy sources are unpredictable / unreliable	accept (most) renewable energy sources depend on the weather	1	
5(c)(ii)	the (proportion of) time that solar storage power stations can generate electricity is greater (than for other renewable energy sources)		1	AO1 P1.4
Total			**14**	

4.6.2.1 Types of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP – JUNE 2015

Question	Answers	Extra information	Mark	AO/Spec ref.
6(a)	Doppler (effect)		1	AO1 P1.5.4a
6(b)	(reflected microwaves) wavelength decreased (reflected microwaves) frequency increased (reflected microwaves) have same speed		1 1 1	AO1 P1.5.4a P1.5.1d
Total			4	

4.6.2.1 Types of electromagnetic waves

Question	Answers	Extra information	Mark	AO / Spec. ref.
7(a)	4200	allow **2** marks for correct substitution ie 6930 = 0.330 x c x 5.0 answers of 1050 **or** 840 **or** correctly calculated answer from correct substitution of incorrect temperature change **or** identification of temperature change ie 5 ˚C gain **1** mark	3	AO2 AO1 P1.1.4d
	J/kg˚C	accept J/kg K	1	
7(b)	(in a metal) free electrons	to gain full credit the answer must be in terms of free electrons	1	AO1 P1.1.3a
	gain kinetic energy	accept move faster	1	
	(free electrons) transfer energy to other electrons / ions / atoms	do **not** accept particles	1	
	by collision		1	
		allow a maximum of **2** marks for answers in terms of atoms / ions / particles • gaining kinetic energy or vibrating faster / more • transferring energy by collisions		
7(c)	(air) particles spread out		1	AO1 P1.1.3a
	(which causes the) air to become less dense / expand	do **not** accept particles become less dense	1	
	(so the) warm air rises	do **not** accept heat rises particles rise is insufficient	1	
7(d)	large surface area	ignore references to type of metal or external conditions	1	AO1 P1.1.3c
	black / dark (colour)		1	
Total			**13**	

4.6.2.1 Types of electromagnetic waves

AQA

GCSE

Science A / Physics

PH1HP

Mark scheme

4405/4403
June 2016

Version 1.0: Final Mark Scheme

4.6.2.1 Types of electromagnetic waves

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4.6.2.1 Types of electromagnetic waves

Mark Scheme

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2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

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2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of errors / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

4.6.2.1 Types of electromagnetic waves

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

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However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(.....) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Accept / allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

3.9 Ignore / Insufficient / Do not allow

Ignore of insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

4. Quality of Communication and levels marking

In Question **2(b)** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic
- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear
- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed
- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

4.6.2.1 Types of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)	frequency		1	AO1 1.5.3b
1(b)	echo(es)		1	AO1 1.5.3c
1(c)	spreading (out)	changing direction is insufficient moving apart is insufficient bending is insufficient	1	AO1 1.5.1g
	equal to	accept: similar to same (order of magnitude) as slightly smaller than slightly larger than	1	
1(d)	340 (m/s)	allow **1** mark for correct substitution ie 25 000 x 0.0136 provided no subsequent step **or** allow **1** mark for a correct calculation showing an incorrect value from conversion to hertz x 0.0136 an answer of 0.34 gains **1** mark	2	AO2 1.5.1j
1(e)		both marking points may appear as labels on a diagram		AO1 1.5.1b
	(a wave where the) oscillations are parallel to the direction of energy transfer	accept vibrations for oscillations accept in same direction as for parallel to allow direction of wave (motion) for direction of energy transfer	1	
	causing (areas of) compression and rarefaction	accept correct description in terms of particles mechanical wave is insufficient needs a medium to travel through is insufficient	1	
Total			**8**	

4.6.2.1 Types of electromagnetic waves

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)	any **one** from: • high cost of installing overhead power lines or underground cables or pylons • high cost as (very) long cables needed • amount of electricity required is too low	allow not enough (surplus) electricity would be generated	1	AO1 1.4.1e

Question 2 continues on the next page . . .

4.6.2.1 Types of electromagnetic waves

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(b)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.		6	3 AO1 2 AO2 1 AO3 1.4.1b

0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant information	at least **one** advantage **or one** disadvantage of either method	at least **one** advantage **and one** disadvantage is stated for **one** method **and** a different advantage **or** disadvantage is stated for the other method	clear comparison of advantages **and** disadvantages of **each** method

examples of physics points made in the response	extra information
Advantages of both methods: • both renewable sources of energy • both have no fuel (cost) • both have very small (allow 'no') running costs • no carbon dioxide produced	 accept carbon neutral accept no greenhouse gases accept doesn't contribute to global warming
Advantages of wind: • higher average power output	 produces more energy is insufficient
Advantages of hydroelectric: • constant / reliable power (output) • lower (installation) cost	
Disadvantages of wind: • higher (installation) cost • variable / unreliable power output • (may) kill birds / bats	
Disadvantages of hydroelectric: • lower power output • (may) kill fish or (may) damage habitats • more difficult to set up (within river)	
Disadvantages of both methods • (may be) noisy • visual pollution	 ignore payback time unless no other relevant points made ignore time to build for both

Total			7

4.6.2.1 Types of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)	a proportion / percentage of the energy is wasted	allow heat for energy allow some energy is wasted	1	AO2 1.2.1b 1.2.1c
	(wasted) energy is transferred to surroundings **or** energy is needed to heat pan (before food is heated)		1	
3(b)	(fins have a) large(r) surface area	accept fins increase the surface area	1	AO1 1.1.1c 1.1.1e 1.1.3c
	(black metal surface is a) good / better absorber of infrared radiation	allow 'heat' or 'energy' for infrared radiation ignore good emitter of infrared radiation not a good reflector is insufficient	1	
3(c)	the higher the temperature (of the saucepan) the greater the rate at which infrared radiation is emitted	accept converse answer allow the higher the temperature the more infrared radiation is emitted allow there is a positive correlation	1	AO2 1.1.1b
Total			**5**	

4.6.2.1 Types of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)(i)	**use of infrared:** remote controls fibre optic (communications) **use of microwaves:** mobile/cell phones satellite (communications/TV) wi-fi Bluetooth	 accept mobiles accept phone signals	1 1	AO1 1.5.1k
4(a)(ii)	any **two** from • same speed **or** travel at the speed of light (in a vacuum) • transverse • transfer energy (from one place to another) • can be reflected • can be refracted • can be diffracted • can be absorbed / transmitted • can travel through a vacuum/space • can be polarised	 accept a full description of a transverse wave travels in straight lines is insufficient	2	AO1 1.5.1c 1.5.1d 1.5.1e 1.5.1g
4(b)(i)	Cosmic Microwave Background (Radiation)	accept CMBR	1	AO1 1.5.4d
4(b)(ii)	 the Big Bang (theory) predicted the existence of CMBR **or** only the Big Bang (theory) supports the existence of CMBR	allow microwave radiation for CMBR throughout allow it supports / proves the Big Bang (theory) accept CMBR disproved other theories, eg steady state	 1	AO1 1.5.4e
Total			**6**	

4.6.2.1 Types of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	no particles (in a vacuum) (so) no / reduced conduction and no / reduced convection	 both energy transfer methods needed for the mark	1 1	AO1 1.1.3a
5(b)(i)	78 (°C)	allow **2** marks for correct temperature change ie 22 ˚C allow **1** mark for correct substitution ie 46 200 = 0.5 x 4200 x θ **or** $\frac{46200}{0.5\times4200}=\theta$	3	AO2 1.1.4d
5(b)(ii)	6.4 (W)	allow **2** marks for an answer that rounds to 6.4 allow **1** mark for correct substitution ie 46 200 = P x 7200 an answer of 23 000 or 23 100 or 385 gains 1 mark	2	AO2 1.3.1c
Total			**7**	

4.6.2.1 Types of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)	any **two** from: • cost per kWh is lower (than all other energy resources) • infrastructure for nuclear power already exists • more reliable (than renewable energy resources)	allow it is cheaper ignore fuel cost ignore energy released per kg of nuclear fuel accept cost of setting up renewable energy resources is high accept many renewable power stations would be needed to replace one nuclear power station accept (France in 2011 already had a) surplus of nuclear energy, so less need to develop more renewable capacity for increased demand in the future accept France benefits economically from selling electricity accept (nuclear) fuel is readily available ignore destruction of habitats for renewables	2	AO1 AO2 1.4
6(b)	any **two** from: • non-renewable • high decommissioning costs • produces radioactive / nuclear waste • long start-up time • nuclear accidents have widespread implications	allow nuclear fuel is running out accept high commissioning costs allow waste has a long half-life allow for nuclear accident a named nuclear accident eg Fukushima, Chernobyl ignore visual pollution	2	AO1 1.4.1f

Question 6 continues on the next page . . .

4.6.2.1 Types of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(c)	0.48 (kW)	allow **1** mark for correct substitution ie 0.15 = P / 3.2 an answer of 480 W gains **2** marks an answer of 48 or 480 scores **1** mark	2	AO2 1.2.1d
6(d)	the higher the efficiency, the higher the cost (per m^2 to manufacture)	accept a specific numerical example	1	AO2 AO3 1.4.1c
	more electricity could be generated for the same (manufacturing) cost using lower efficiency solar panels **or** (reducing the cost) allows more solar panels to be bought	accept a specific numerical example	1	
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	surface area **or** duration of experiment	accept shape of beaker size of beaker is insufficient	1	AO3 1.1.3b
7(b)	any **two** from: • takes readings automatically • takes readings more frequently • reduces / no instrument reading error • higher resolution • don't need to remove probe to take reading • more accurate	ignore easier **or** takes readings for you ignore human error allow better resolution	2	AO3 1.1.3
7(c)(i)	0.07 (°C/s)	allow **1** mark for obtaining a temperature drop of 7(ºC) allow **1** mark for an answer between 0.068 and 0.069 (°C/s)	2	AO2 1.1.3d
7(c)(ii)	rate of temperature change is greater at the start **or** rate of temperature change decreases	accept rate of evaporation is greater at the start allow rate of evaporation decreases allow temperature decreases faster at the start	1	AO3 1.1.3b

Question 7 continues on the next page . . .

4.6.2.1 Types of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(c)(iii)	A lower temperature decrease (over 200 seconds)	reason only scores if A is chosen accept lower gradient	 1	AO3 1.1.3b
7(c)(iv)	no effect (as rate of evaporation is unchanged)	allow larger temperature change (per second as mass of liquid is lower)	1	AO3 1.1.3b
7(d)	particles with more energy leave the (surface of the) liquid (which) reduces the average (kinetic) energy (of the remaining particles)	accept particles with higher speeds allow reference to the total energy of the liquid reducing	1 1 1	AO1 1.1.3b
Total			**11**	

4.6.2.1 Types of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(a)	any **two** factors: • surface area (of mug in contact with cup warmer) • thickness of mug • temperature of heater / coffee • power of the heater	 accept temperature difference (between heater and coffee) accept power of the laptop ignore efficiency of the heater	2	AO3 1.1.3c
8(b)	atoms (gain kinetic energy and) vibrate faster / more energy is passed on from atom to atom by collision	allow particles / molecules for atoms allow bigger / faster vibrations do not accept start to vibrate accept vibrations for energy an answer in terms of free electrons scores zero	1 1	AO1 1.1.3a
8(c)	the particles spread out (so) coffee becomes less dense (so) the heated coffee rises (and) cooler / denser coffee falls	allow fluid / liquid / water for coffee throughout answer allow particles move further apart allow (coffee) expands particles rise is insufficient particles fall is insufficient	1 1 1 1	AO1 1.1.3a
Total			8	

4.6.2.1 Types of electromagnetic waves

Answer 69 · Examiner comments — June 2019 | 8463/2H | Original Q7

Question 7 (Standard and standard/high and high demand)

07.1 Around 42% of the students scored this mark. Many students seem to think that the wave speed changes.

07.2 About 35% of the students scored both marks. Some students did not specify 'soft' tissue or a named soft tissue, which was required as bone is a tissue. Many students incorrectly described bones as reflecting X-rays rather than absorbing them. Some students appeared to confuse X-rays with gamma rays or even alpha particles.

07.3 A large number of the students failed to appreciate that the hot cube was the main hazard rather than the kettle. The majority gave an answer in terms of 'wear safety goggles and/or

Answer 69 · Examiner comments — June 2019 | 8463/2H | Original Q7

gloves. Less than a quarter of the students gave a correct answer, these appeared to be evenly distributed across the alternatives given in the mark scheme.

07.4 Only a quarter of the students scored this mark, with most incorrect answers giving the temperature or volume of the water as the control variable.

07.5 There appeared to be some confusion of the term precise with either accuracy or resolution. The lack of repeat readings was sometimes given but then incorrectly linked to the idea of calculating a mean or identifying anomalies. About 10% of the students scored this mark.

07.6 About 64% of the students realised that two of the surfaces would give the same temperature reading and therefore undermine the conclusion. However most of these students then simply wrote that the conclusion would not be valid without then going on to explain why.

07.7 Just over 70% of the students gave the correct answer.

07.8 Only a small number of the students scored any marks on this question. Those that did usually scored the mark for 'clouds reflect radiation'. Virtually no students related their answer to night time. Marking points 1 and 3 were rarely awarded. Many of the students wrote about insulation with a few mentioning the cloud as a 'blanket' keeping the ground warm. These answers did not score any marks.

Answer 70 · Examiner comments — November 2021 | 8463/2H | Original Q5

Question 5

Although a number of correct uses were given for ultraviolet a number of the students appeared to confuse UV with ultrasound. The meaning of the prefix 'nano' was not well known. However the students that knew the correct equation for part **05.3** (about 35% did not) did go on to use the value chosen in **05.2** to calculate a correct answer. Only about half of the students could use the data presented in Table 1 to correctly answer part **05.4.** Most of the students scored no marks for part **05.5**, with many either simply giving an example of each type of wave, or failing to link the direction of oscillation to either direction of energy transfer or direction of wave travel.

4.6.2.1 Types of electromagnetic waves

Answer 72 · Examiner comments June 2024 | 8463/2H | Original Q3

03.1
Generally, well answered with 50% of students gaining all 3 marks for naming types of object that make up our solar system, and 35% getting 2 marks. Many students did not make the distinction between artificial and natural satellites. A number listed different stages in the life cycle of stars.

03.2
94% of students chose the star mostly likely to become a black hole. A common incorrect answer was Cynus A, the star with the lowest mass.

03.3
56% of students were able to convert gigametres to metres.

03.4
This is always a difficult topic for students. Many students recognised that galaxy A is travelling faster. A large number of students didn't clearly state the light spectra were showing red-shift or that the galaxies were moving away from us, so were unable to achieve the first and / or the second mark points. Students who stated the light spectra were showing red-shift often went on to achieve all 3 marks (17%).

03.5
63% of students scored all 4 marks for this calculation of time. The most common error was not converting the distance to metres. Some students got confused dividing numbers in standard form, ending up with an incorrect power.

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Answer 72 · Examiner comments June 2024 | 8463/2H | Original Q3

03.6
23% of the students were able to give a complete account of how all the elements larger than hydrogen formed and achieve level 2. 24% gave partial accounts that missed out a stage and a 25% gave only a beginning, a middle or an end. The remainder mentioned the lives of stars without mentioning fusion or the processes at all, or clearly had no idea what a star was or described chemical bonding of gas molecules. 47% of the students gained 1 or 2 marks in this question but those who achieved level 2 showed a good understanding beyond recall, suggesting that this topic has been well established in the teaching and is one that many students have a passion for.

4.6.2.1 Types of electromagnetic waves

Answer 73 · Examiner comments June 2025 | 8463/2H | Original Q4

4.1
This question was answered well. The majority of the students correctly stated 'convex' as the type of lens. 'Converging' was occasionally used.

4.2

Answer 73 · Examiner comments June 2025 | 8463/2H | Original Q4

Almost three quarters of the students scored both marks for completing the ray diagram. However a significant number of the others tried adding objects, images or additional incorrect lines.

4.3
Approximately half of the students failed to convert the wavelength correctly. Some of the students struggled with the rearrangement, but there were also numerous examples of mathematical errors for example 3.0/0.6 = 0.5 or 3.0/6.0 = 5. There was also a notable lack of understanding regarding the use of standard form. Students also need to understand that answers given in standard form are perfectly acceptable.

4.4
Only just over half of the students knew that when radiation is red-shifted there is an increase in wavelength. Incorrect answers such as 'frequency' and 'wave speed' were commonly seen.

4.5
Over 93 % of students knew why radiation from distant galaxies is red-shifted.

4.6
This question tested awareness of what red-shift tells us. Just fewer than 60% of the students gained this mark. Many of the students knew how red-shift related to speed but not the relationship between greatest red-shift and greatest distance away.

4.7
The James Webb Telescope orbits the Sun and those students who read the question carefully answered in terms of the Sun, but sometimes focussed on the different speeds at different points of an elliptical orbit. The majority of the students did not understand the Physics of circular orbits but were able to state that to stay in a circle the direction had to be constantly changing.

4.6.2.1 Types of electromagnetic waves

AQA
Questions matter

GCSE

Physics

8463/1H Paper 1 Higher Tier

Report on the Examination

8463
June 2024

Version: 1.0

4.6.2.1 Types of electromagnetic waves

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4.6.2.1 Types of electromagnetic waves

REPORT ON THE EXAMINATION – GCSE PHYSICS – 8463/1H– JUNE 2024

General

Grade 4-5 calculation questions ask for students to recall an equation first before using it in a subsequent calculation, however in the 2024 series, students were given a Physics Equations Sheet which had all the equations printed on it. Subsequently, the performance on straightforward calculations has improved compared with years when equations have needed to be recalled from memory.

The grade 8-9 multistep calculations, question **05.5** and **06.2**, were well attempted. Question **05.5** had 18% of students scoring 5 marks, while question **06.2** had 14% of students scoring 6 marks.

Question **03.1** was well attempted and students who had carried out the resistance of a wire required practical would have had a material advantage over those who hadn't. For this question, 44% of students scored 5 or 6 marks and 37% of students scored 3 or 4 marks.

Handwriting continues to be a problem for a number of students, making it very difficult for examiners to read what has been written. An increasing number of students are using computers to word process their answers for extended response questions, which is helpful for examiners in awarding credit for student responses. However, students must use the question number as printed in the question paper eg 4.3 rather than 4(c) to ensure that their work is marked with the corresponding question part.

Levels of demand

Questions are set at three levels of demand for this paper:

- **Standard demand** questions are designed to broadly target grades 4–5.
- **Standard/high demand** questions are designed to broadly target grades 6–7.
- **High demand** questions are designed to broadly target grades 8–9.

A student's final grade, however, is based on their attainment across the qualification as a whole, not just on questions that may have been targeted at the level at which they are working.

Question 1 (Standard Demand)

01.1 98% of students scored this mark, identifying the energy store which increases when water is heated.

01.2 93% of students scored this mark. Some incorrect answers seen were 'method A' or 'method B' students thinking they were linking a method to the energy transfer. Another common answer was 'hydroelectric energy' which didn't score. The word 'potential' was needed for an answer of 'gravitational potential.' As the question was worded it seemed reasonable to credit 'kinetic' since the water moving uphill would have kinetic energy before it reached its destination and stored only gravitational potential energy.

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4.6.2.1 Types of electromagnetic waves

01.3 55% of students scored 4 marks. Some students failed to realise that the calculations needed were to show the amount of stored energy wasted or the amount of stored energy usefully transferred. Simple subtractions were insufficient to score the calculation marks. To score 4 marks, two comparisons were needed in addition to a comparative calculation. Although the comparative calculation performed by a minority of students involved dividing 33 600 kJ by 490 kJ and getting an answer of 68.6, which is the number of times more energy stored by method A compared to B. This single calculation was enough to score 4 marks with the two simple comparisons. The installation comparison only scored if value was added to the information eg Method A is easier to install or is likely to cost less money.

01.4 To score marks for this question, students needed to say what activity should be stopped (or reduced) and what should be done instead for both transport and electricity generation. At its simplest this could be use electric cars instead of petrol cars and use renewable methods instead of fossil fuels to generate electricity. As well as the examples on the mark scheme other valid methods were also creditworthy: car sharing, for example, or limiting the distance that goods could be shipped across country. 39% of students scored 4 marks, while 35% of students scored 3 marks.

Question 2 (Standard Demand)

02.1 A sentence completion question about nuclear fission which discriminated well between students. 72 % of students scored 3 marks, 21% scored 2 marks and 5% scored 1 mark.

02.2 99.5% of students scored the mark for writing down the correct equation. However, in this exam series all equations were provided for the students on the Physics Equations Sheet.

02.3 A standard demand calculation of energy question. 48% of students scored 3 marks, while 41% of students scored 2 marks. Not converting or incorrectly converting the unit will have allowed many students to only score 2 marks.

02.4 44% of students scored a mark. ‘Wear protective clothing’ or ‘hazmat suits’ were common incorrect answers. Any idea of ‘burying it’ was credited, so ‘bury it in a field’ was ok, as was ‘bury it in landfill,’ which from a student’s perspective is equivalent to burying it underground. ‘Keeping it away from people’ was insufficient.

02.5 96% of students scored 2 marks. The answer of 29.2 days was worth 1 mark as this could only have been calculated by doing the correct calculation and then subtracting the result from 365.

Question 3 (Standard/High Demand)

03.1 Students who had completed the investigation found this question straightforward, especially as the circuit was shown in a photo. It was not necessary for the circuit connections to be described. The mean mark for the question was 4 marks. 44% of students scored 5 or 6 marks, while 37% of students scored 3 or 4 marks.

03.2 83% of students identified the graph showing the relationship between length of wire and resistance.

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03.3 28% of students scored 2 marks, while 50% scored 1 mark. The converse of 'low p.d.' was the bare minimum to score the first mark, so 'not a high p.d.' was taken to mean the p.d. was low. Similarly, 'not enough to give you a shock' and 'not enough to electrocute you' were creditworthy for the second mark.

Question 4 (Standard/High Demand)

04.1 Students answers were generally very confused with this question and statements about transfer of positive electrons or protons or even neutrons were commonly seen. Students struggled to understand that when you are in contact with a charged object you have the same charge as that object. It was common to see statements about the dome being negative so the student (and her hair) are positively charged. If a student said that the student was positively charged they could not score mark points 1 and 2, but they could still score mark point 3 if they said that like / same charges repel. 10% of students scored 3 marks, while 15% scored 2 marks and 32% scored 1 mark.

04.2 Only 8% of students scored a mark on this question. An answer of 'the area / space / region where an electron experiences a force' was creditworthy as were other examples of charged particles or ions. 'The area where other charged particles experience repulsion or attraction' was also creditworthy. Neither of these examples were seen often, however.

04.3 92% scored a mark for this question. A surprisingly large number of students made statements like 'as you get closer to the dome, the field strength increases' answering the question in the opposite way to the way it was set out. They scored a mark but would have saved a lot of time by writing 'it decreases.'

04.4 Some students did not convert, or incorrectly converted, the unit of charge and scored 3 marks.. Some students incorrectly converted the unit for charge and also spuriously converted the energy by multiplying or dividing by a power of ten. These students made two mistakes, so scored a maximum of 2 marks on this question. 36% of students scored all 4 marks, while 56% of students scored 3 marks for this calculation of potential difference.

04.5 80% of students identified the factor that would increase the distance a spark can jump between two objects.

Question 5 (Standard/High Demand)

05.1 72% of students scored 2 marks, while 15% of students scored 1 mark. A number of students thought mains p.d. was 240 V. It was officially changed to 230 V in 1987 and this is the value given in the specification. However, it was more common for students to get the p.d. correct and the frequency incorrect.

05.2 A grade 6-7 calculation of resistance, which discriminated well between students. The conversion of milliwatts to watts proved a problem for the vast majority of students. 53% scored all 4 marks, while 36% scored 3 marks.

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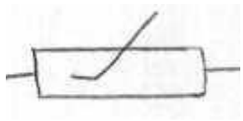
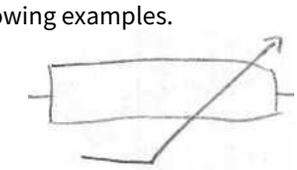
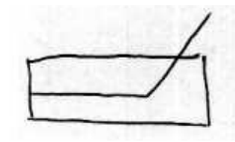
4.6.2.1 Types of electromagnetic waves

05.3 64% of students scored a mark for suggesting why dirty coins are not recognised by the machine. Answers which were insufficient, but ignored, included 'Can't measure resistance' and 'Dirt is an insulator'..

05.4 63% of students scored a mark for drawing the thermistor symbol. Answers that were not acceptable included the following examples.

05.5 This grade 8-9 calculation, worth 5 marks, question discriminated well between students of different abilities. If a student did not calculate the total resistance and then use that value to calculate the current in the circuit, then they didn't score the first 3 marks. If a student calculated the current in the circuit using just the 400 Ω resistor, then they could use that value to score the 4th and 5th marks for the calculation of the p.d. across the thermistor, using $V = IR$.
Answers with a p.d. greater 12 V usually scored zero marks, due to fundamental Physics errors.
18% of students scored 5 marks, while 31% of students scored 2 marks. 46% of students scored 0 marks. In this exam series all equations were provided for the students on the Physics Equations Sheet.

Question 6 (High Demand)

06.1 90% of students scored this mark, for identifying that the elastic potential energy store increases as the bungee cords are stretched.

06.2 A challenging grade 8-9 calculation question. A common incorrect answer was '10' which scored 5 marks because the only mistake the student made was not doubling the elastic potential energy calculated for one bungee cord. Due to the various ways students approached the question it discriminated well between different abilities. 14% of students scored 6 marks, while 34% scored 5 marks and 28% scored 4 marks. As long as a student had used the elastic potential energy equation calculating a value of E_e using a value of k and e^2 they could score the marks for using the E_p equation.

06.3 12% of students scored 2 marks, while 46% of students scored 1 mark, in this question for identifying the ways in which energy was dissipated.

Question 7 (Standard/High Demand)

07.1 52% of students scored this mark. The question states that the student's eye is not in line with the level of the water. The position of the eye is likely to remain in the same (incorrect) position as the water level changes when the ring is inserted. This will cause a random error as both volume measurements will be incorrect, but not by the same amount.

07.2 63% of students scored this mark. Additional mass or absorbing extra water were ignored. The answer needed to make a comparison, rather than just state that 'volume of string affects the measurement of volume.'

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07.3 33% of students scored the mark for this question about resolution. Comments on low / high resolution were insufficient to score. Statements needed to refer to the resolution value itself or the number of decimal places the measurement could be read to. As measuring cylinders often have large gaps between markings, a statement that the resolution was 0.1 cm^3 was allowed.

07.4 71% of students scored a mark for this question about zero error. Common incorrect answers said, 'take repeat readings and calculate a mean.'

07.5 A grade 6-7 calculation question, but the unit conversion made this question more difficult than other similar calculations in the exam, with only 33% of students scoring all 4 marks. 57% of students scored 3 marks.

Question 8 (High Demand)

08.1 Questions about the microscopic causes of pressure are difficult for GCSE students and this question was no exception. Many students repeated information given in the question which did not score any marks. A minority of students scored the first mark point, many students simply stating that the volume decreased which was insufficient. Students made a good attempt at explaining that there were more collisions between the particles and the container walls, but failed to score because they didn't refer to a specified time period e.g. per second, or rate or more frequent, etc. Some students stated that the kinetic energy of the particles had increased, which stopped them from scoring the second mark point. Very few students scored the third mark point which was the most demanding of the three. 9% of students scored 2 or 3 marks, while 43% of students scored 1 mark.

08.2 94% of students scored this mark, linking temperature increase to mean kinetic energy of particles.

08.3 A grade 6-7 calculation question which discriminated well between students. Many students failed to convert the specific heat capacity so scored 3 marks instead of 4. Some students tried to convert the energy into kJ but very few did this successfully, usually ending with a 'power of 10' error. 22% of students scored 3 marks while 62% of students scored 4 marks.

Question 9 (High Demand)

09.1 Students needed to refer to the graph, and factual recall about alpha radiation, to score the 1st and 3rd mark points.,. The 2nd mark point was much more unlikely to score, as students often stated the graph went to zero, rather than being just above zero. A number of students confused the graph with a half-life graph, believing the *x*-axis showed time, not distance. 8% of students scored 3 marks, while 45% scored 2 marks and 35% scored 1 mark.

09.2 A lot of students thought it was enough to say 'an absorbing material' without specifying what the absorbing material should be made from. Any suitable absorbing material was creditworthy, a block of wood for example. However, reference to any metal foil was not creditworthy unless students referred to a certain thickness eg 5 mm thick aluminium foil. A 'foil' was taken to be the same thickness as kitchen foil, whereas a 'metal sheet' was taken to be thick enough to absorb

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beta radiation, provided students did not contradict their earlier statements. Paper and cardboard were not creditworthy as suitable absorbing materials. 51% of students scored 2 marks, while 7% of students scored 1 mark.

09.3 65% of students scored this mark by suggesting a suitable safety precaution. Hazmat suits and PPE were insufficient to score.

09.4 64% of students scored this mark by suggesting a suitable precaution to avoid contamination. Hazmat suits and PPE were insufficient to score.

09.5 Students at GCSE find the idea of rate of change to be a difficult one, hence linking the change in the number of atoms to activity was a difficult question in this exam series. 7% of students scored 4 marks, while 12% of students scored 3 marks. If students failed to draw a tangent, they were very unlikely to score any marks except the unit mark. A common incorrect choice of unit for activity for many students was sieverts, Sv. Examiners were looking for becquerel or Bq. Decays per second or decays/second were insufficient to score.

Question 10 (Standard/High Demand)

10.1 72% of students correctly identified the colour of the live wire insulation.

10.2 66% of students scored the mark on this question. Students who made the box for the answer into a fuse symbol did not score the mar nor did a fuse symbol added to any side of the box .

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10.3 A grade 6-7 calculation of current. 57% of students scored all 4 marks. 36% of students scored 3 marks, usually for incorrectly converting, or not converting, the unit.

10.4 A grade 6-7 calculation of mass. 61% of students scored 4 marks. 31% of students scored 3 marks for either incorrectly converting, or not converting, the unit.

10.5 40% of students scored 2 marks on this question recognising that the time would be longer because more energy in total would need to be transferred. An answer of ‘less energy is melting the wire’ was just enough to score the second mark. 15% of students scored zero on this question.

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4.6.2.1 Types of electromagnetic waves

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

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